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SMALL-SCALE HYDROELECTRIC POWER IN THE PACIFIC NORTHWEST: NEW IMPETUS FOR AN OLD ENERGY SOURCE

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ACKNOWLEDGMENT

The staff of the NCSL Small-Scale Hydroelectric Power Policy Project wishes to thank the Department of Energy for the opportunity to sponsor this conference.

We extend our thanks and best wishes to the speakers, workshop facilitators, panel members, and rapporteurs for their time and effort.

Special appreciation goes to State Senator Paul Hess for his participation as moderator of the Conference.

Finally, we wish to thank the staff of the Energy Law Institute of the Franklin Pierce Law School for their on-going assistance and material. We would also like to acknowledge the communication efforts and representation at our conferences of Mr. Ron Corso and other members of the Federal Energy Regulatory Commission.

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FOREWORD

Energy supply is one of the most important issues facing Northwestern legislators today. To meet the challenge, state legislatures must address the development of alternative energy sources. The Small-Scale Hydroelectric Power Policy Project of NCSL has been designed to assist state legislators in looking at the benefits of one alternative, small-scale hydro.

Because of the need for state legislative support in the development of small-scale hydroelectric, NCSL, as part of its contract with the Department of Energy, conducted the following conference on small-scale hydro in the Pacific Northwest. The conference was designed to identify state obstacles to development and to explore options for change available to policymakers. We hope the following summary of the conference proceedings will serve as a reference for those who attended the conference and as a new source of information on small-scale hydro for those who did not participate.

NCSL is the official representative of the country's 7,500 state legislators and their staffs. NCSL's Small-Scale Hydroelectric Power Policy Project is funded through a grant awarded by the Department of Energy to inform state legislators about the problems and opportunities for the development of small-scale hydroelectric. Project staff, in cooperation with other DOE contractors, will identify and describe legal, institutional, environmental, and economic obstacles to development, and outline alternative policies which are consistent with rapid and efficient utilization of this renewable energy resource. The NCSL project is an outreach effort to the state legislatures.

ATTACHMENT A

SMALL-SCALE HYDROELECTRIC POWER IN THE PACIFIC NORTHWEST: New Impetus for an Old Energy Source

The Portland Hilton Hotel
Portland, Oregon
July 12-13, 1979

AGENDA

THURSDAY, JULY 12th

8:00-9:00 am — REGISTRATION (*Ballroom Foyer*)

9:00-9:20 am — WELCOME & INTRODUCTIONS (*Ballroom B*)
- State Senator Paul Hess, Kansas

9:20-11:25 am — PRESENTATIONS (*Ballroom B*)
- Sterling Munro-Bonneville Power Administration
- Richard Cellarius-Sierra Club
- James Huffman-Natural Resources Law Institute, Lewis & Clark Law School
- David Auslam-Auslam & Associates
- Nelson Jacobs-Bureau of Reclamation
- Ronald Corso-Federal Energy Regulatory Commission

11:25-11:45 am — QUESTION & ANSWER SESSION (*Ballroom B*)

12:00-1:30 pm — LUNCHEON (No-Host) (*Pavilion Room*)
- Keynote Speaker: Assemblyman Meldon Levine, California

1:30-5:30 pm — WORKSHOP SESSIONS
- Topics & Workshop Facilitators

State/Federal Barriers & Incentives
- Peter Brown-Franklin Pierce Law Center (*Studio Suite*)
- Anthony Buxton-Franklin Pierce Law Center (*Room 323*)

Economics of Small-Scale Hydro
- David Auslam-Auslam & Associates (*Directors Suite*)
- David Willer-Tudor Engineering (*Forum Suite*)

Natural Resources & Environmental Issues
- Steve Hildebrand-Oak Ridge National Laboratory (*Petite Suite*)
- Richard Cellarius-Sierra Club (*Council Suite*)

5:30-7:00 pm — RECEPTION (Hosted by NCSL, Cash Bar) (*Pavilion Room*)

FRIDAY, JULY 13th

8:30-9:00 am — COFFEE SERVED (*Ballroom Foyer*)

9:00-10:00 am — REVIEW OF CASE STUDY (*Ballroom B*)
- Larry Schwartz-University of Washington
- Site: South Columbia Irrigation District, Pasco, Washington

10:00-10:15 am — BREAK (*Ballroom Foyer*)

10:15-10:35 am — PRESENTATION (*Ballroom B*)
- John Warren-Research Triangle Institute

10:35-11:40 am — RECOMMENDATIONS & SUMMARY OF WORKSHOP SESSIONS (*Ballroom B*)
- State Senator Paul Hess, Kansas

11:40-12:00 Noon — CHECK OUT TIME AT THE HOTEL

12:00-1:30 pm — LUNCHEON (Hosted by NCSL) (*Pavilion Rm*)
- Keynote Speaker: Senator Ted Bottiger, Washington

1:30-3:00 pm — PLENARY SESSION (*Ballroom B*)
- Moderator: State Senator Paul Hess, Kansas
- Panel Members:
  - Ronald Corso-Federal Energy Regulatory Commission
  - Bob McKinney-Cowlitz Public Utility
  - Ted Bottiger-Senator, Washington
  - John Lobdell-Public Utility Commission,
  - Nels Anderson-Representative, Alaska
  - Robert Lee-Portland General Electric Company

3:00-3:15 pm — CLOSING REMARKS (*Ballroom B*)
- Ronald D. Smith-National Conference of State Legislatures

3:15 pm — ADJOURN

SUMMARY

The Pacific Northwestern Conference, "Small-Scale Hydroelectric Power: New Impetus for an Old Energy Source" was convened to provide a forum for the discussion and direct conferee participation in identifying and solving problems surrounding the development of small-scale hydroelectric power.

During the two-day meeting state legislators and legislative staff, dam developers, representatives of utilities and industry, environmentalists, and federal/state officials examined and discussed the problems impeding small-scale hydroelectric development at the state level. The discussions yielded alternative policy options which will be considered by the U.S. Department of Energy, state legislators, and NCSL staff. Emphasis was placed on the legal, institutional, environmental and economic barriers at the state level, as well as the federal delays associated with licensing of small-scale hydro projects. Whereas other previously-held conferences emphasized the identification of small-scale hydro as an alternative resource and its technology, this conference stressed the necessity of legislative resolution of the problems and anaylzed the causes of delays in small-scale hydro licensing and development at the state level.

While developing the policy recommendations, conferees, guided by workshop faciliators, sought answers to such questions as, What should the government role be in making small-scale, hydro development attractive and affordable? What kind of financial incentives do dam developers need from the states? How might fulfillment of natural resource laws affecting small-scale hydroelectric development be expedited? What are the major legal and institutional barriers to small-scale hydroelectric development at the state level and how do they affect each type of dam developer? What kind of policies are needed to ameliorate these barriers?

While not all of the problems could be resolved with specific policy options, conferees did address most of the topics. Open discussions led a number of state legislators to consider small-scale hydro as an important alternative for their state's energy future.

The following is a brief summary of the Conference Proceedings, followed by copies of the formal presentations of the speakers. Appendix A is a listing of conference participants.

The Conference began on Thursday with resource presentations on the fundamentals of the subject of small-scale hydro and an update on current small-scale hydroelectric research and assessment being carried out by other institutions and agencies..

Assemblyman Meldon Levine gave the luncheon keynote address on the development of small-scale hydro in California. During the afternoon session conferees attended workshops which addressed the economic, natural resource, and state/federal barriers to small-scale hydroelectric development. NCSL hosted a reception after the conference adjourned for the day.

The conference opened the next day with a case study presentation by NCSL subcontractor, the University of Washington. Following the case study review, John Warren of the Research Triangle Institute presented his work with the North Carolina Energy Office.

Senator Ted Bottinger, Washington, gave the luncheon keynote. Final policy recommendations were presented by the various workshop facilitators. The Plenary Session Panel discussion, followed by a question/answer period, completed the conference agenda.

The following materials were distributed at the conference: Issue Briefs, Project Description Paper of Ongoing Small-Scale Hydroelectric Studies and Research (published by the Franklin Pierce Law Center), Conference Packet: agenda, scoping paper, federal regulatory overview (Franklin Pierce Law Center). To obtain copies write: Small-Scale Hydroelectric Policy Project, National Conference of State Legislatures, 1405 Curtis St., 23rd Floor, Denver, Colorado 80202.

STATE SENATOR PAUL HESS
Chairman, NCSL Energy Committee
Conference Moderator

State Senator Paul Hess opened the Conference by welcoming conferees and explaining NCSL's State-Federal Assembly Committee Energy. Senator Hess described NCSL's sponsorship of the Conference as a DOE contractor and explained the organizational representation that had been sought in the preparation of the invitation list.

Following his introductory remarks, Senator Hess discussed the problems of energy supply and the role of the state legislatures in the development of alternative energy sources.

The broad subject of energy is far too complex for simple solutions, he said, but a brief examination by conferees of the problems in development of small-scale hydroelectric should convince us that the subject of energy could be made more simple. Although federal regulations and licensing procedures present barriers to small-scale hydroelectric development, Senator Hess pointed out that there are many serious obstacles at the state level as well. Besides having their own complex and sometimes duplicative regulations, states lack financial incentives and public commitment to small-scale hydroelectric development.

Most state legislatures have no long-range "energy agenda", and react only to the immediate problems of long gas lines and nuclear incidents. In order for state policymakers to include small-scale hydroelectric in their energy development plans, the potential resource must be identified. Senator Hess outlined the Pacific Northwest 's potential small-scale hydroelectric power which was reported in the 1977 study conducted by the Corps of Engineers.

Senator Hess reminded conferees that small-scale hydro is a proven technology and predicted that, even though its costs are high, current events would soon force us to look closely at this power source.

RESOURCE PRESENTATIONS

STERLING MUNRO, Bonneville Power Administration *

In his prepared remarks Mr. Munro sought to discuss three issues: 1) how the Bonneville Power Administration (BPA) small-scale hydro as an energy source for the Northwest, 2) the possibility of the BPA developing a small-scale hydro program, and 3) define BPA's rule in assisting state legislatures in small-scale hydroelectric development.

In addressing the first issue, Munro reported that while the BPA views small-scale hydro as having some potential relative to overall regional needs and is beset with many problems, its development is more feasible today than ever before. He characterized small-scale hydro as an undeveloped potential energy alternative but cautioned conferees to look realistically at the attainable power, which may amount to only a small fraction of that potential. Rather than be discouraged by the realities of the resource, Mr. Munro urged conferees to be glad for the potential that can be developed and to find ways to do it.

Regionally, the Pacific Northwest could be ahead of the rest of the country since its already-developed hydro gives it a boost in the development of renewable resources. However, Mr. Munro expressed doubts about the ease with which we would be able to make the transition to new and renewable resources.

Mr. Munro pointed out, for example, that many of the renewable resources produce power intermittently and require back-up power. The Columbia River System, however, could provide storage to make renewable resources more dependable and, therefore, more marketable and more usable.

He characterized small-scale hydro further by reminding the audience that this was a domestic resource, relatively inflation proof, clean and safe, with zero fuel costs. But Mr. Munro noted, the various degrees of support among interest groups for specific sites.

Mr. Munro identified the major obstacles to small-scale hydroelectric development as the costs and time needed for feasibility studies. He feels that the licensing process is unjust because of the current practice of judging small and large projects equally.

Regarding the Bonneville Power Administration, Mr. Munro reported that the BPA is presently involved in planning studies and could, with additional authority provided in the proposed regional power bill, acquire power generated at small-scale hydro projects and thus be a stimulus to its further development.

However, even with such authority, the BPA could not be a developer of renewable resources but only a potentially willing purchaser of the power. Provisions of the Public Utilities Regulatory Policy Act (PURPA) will further encourage the BPA to exchange energy from small-scale hydro facilities to the federal system.

Mr. Munro explained that the extent to which BPA can play a role in the development of small-scale hydro is still being shaped at the federal level. He indicated that innovative state actions could provide more opportunity for the BPA. Staff is available for load integration and marketing studies. The BPA also provides assistance in preparing other data that would help state regulatory commissions and legislatures promote small-scale hydro.

* NCSL appreciates the presentation given by Mr. Russell Holt of the BPA in place of Mr. Munro

RICHARD CELLARIUS, Sierra Club Board of Directors

Mr. Cellarius discussed the beneficial and adverse effects small-scale hydro power would have on the environment. He noted the growth of the Pacific Northwest and the attendant energy demand it is experiencing. He reminded the audience that the environmental and social impact statement review is used in deciding where small-scale hydro development should take place. Mr. Cellarius recommended that the public review phase of the EIS process be augmented by citizen advisory councils to work with those doing the early planning and feasiblilty studies; he warned against relying upon the standard public notice for public involvement.

Mr. Cellarius reviewed briefly, in a generic sense, the problems of small-scale hydro installation and operation, emphasizing land and water quality issues.

The most visible effects of any project would be on the land itself since many potential sites are in wilderness areas or wild and scenic river corridors. Other sites may impact forest and agricultural lands. Transmission lines could create the most damage.

Water quality could be equally affected: dams disrupt natural siltation and nutrient flow patterns; temperature fluctuations occur and oxygen depletes with the impoundments; fisheries, a great environmental concern, could be lost as spawning ground by dams and turbines, which create physical barriers. Seasonally-regulated flow patterns also interfere with spawning and migrating especially in small streams where small-scale hydro projects are apt to be located.

To deal with some of these concerns the Columbia River Citizens' Compact was formed. The group's basic goals include obtaining: 1) equal rights for fish and wildlife in allocating water for a proposed project, and 2) legal protection for optimum flows, rather than having assurances of minimal flows provided.

Mr. Cellarius went on to emphasize the need for optimum flows, especially during the project's operation and maintenance, since a good project can become distructive if improperly managed. Mr. Cellarius called for designating very specific controls during the planning and environmental analysis process with no variances granted during operation.

Mr. Cellarius then reviewed the various types of small-scale hydroelectric developments, testing them against the concerns he had earlier outlined. For example, 1) refurbishing existing dams may mean dredging, with the accompanying problem of silt disposal; 2) constructing new dams would mean land-use and wildlife problems. Trade-offs between the ensuing destruction of a natural fishery by a new dam and the creation of a fish hatchery would be biologically and aesthetically unacceptable, he maintained.

Installation of a turbine-generator system or no-dam method would eliminate many potential problems created by impoundments but still could interfere with the natural flow of a stream.

Finally, Mr. Cellarius emphasized the need for thorough site analyses and reiterated the need to keep the public involved early in the development process. He cautioned conferees against trying to find ways to circumvent natural resource requirements and recommended that program analyses be undertaken to review the number of potential sites and overall impact of developing them. Mr. Cellarius said that small-scale hydro does have an important place in the category of renewable energy sources, but he felt that we should make mandatory conservation measures a priority.

NELSON JACOBS, Bureau of Reclamation *

Mr. Jacobs described the role of the Bureau, emphasizing the construction and operation of 50 hydroelectric power plants and

transmission lines in the West. He reported that studies were underway to investigate expanding the capacity at existing plants. Mr. Jacobs also reported on the Western Energy Expansion Study (WEES) completed in 1977. Potential hydroelectric developments were evaluated and put on the agenda for further study according to current criteria of economic, environmental, and social concerns. As a result of that study the Bureau now has in progress 31 planning studies, most of which represent small additions to existing Bureau facilities.

Historically, hydro power in the West has usually meant large, high-head plants. But now that most of those sites have been developed, the highest ranking of potential developments are additions to existing Bureau facilities and small-scale hydroelectric projects.

As a result of the WEES Study, the Bureau is now evaluating low-head hydroelectric in 17 western states. The work is being coordinated with the Corps' national hydropower study and will be conducted in three phases. The first phase will identify potential additions to existing dams, diversion and canal drops. Economic and financial analyses will also be made.

Phase II will constitute the major inventory phase including a screening of earlier Corps data. Further identification of unnamed low-head sites will be analyzed for power and energy potential and economic attractiveness.

Phase III involves site selection based on the inventory work completed in the second phase. These sites will undergo further evaluation for potential federal development. Again, economic and financial feasibility will be analyzed and data on environment and social impact will be collected.

The Bureau is now actively investigating the possibility of integrating wind and solar energy into its current hydropower system, and will soon be studying the uprating potential of all operating units at working powerplants.

The Bureau is also cooperating with DOE in several general studies of low-head hydro technology. One involves cost data and is under contract with Tudor Engineering. Another is a study of the marketability of power and energy produced by small-scale hydro being carried out by Systems Control. A joint study by the National Marine Fisheries Service and the Idaho Power Company. The Bureau is probing the cause of fish mortality that occurs when fish swim through low-head turbines.

These five studies are in various stages of completion and are scheduled to be published by the end of FY 1980, according to Mr. Jacobs.

The role of the Bureau is increasing as the nation's energy crisis intensifies, Mr. Jacobs believes small-scale hydro can contribute dependable baseload energy supplies, especially in areas where oil supplies are used for that purpose. And irrigation canal drops, where firm seasonal power and energy can be produced, small-scale hydro could offset an equivalent seasonal peak demand for irrigation pumping.

* NCSL appreciates the presentation given by Mr. Wayne Fernelius of the Bureau's Washington Office in place of Mr. Jacobs.

JAMES HUFFMAN

A formal text of Mr. Huffman's presentation was unavailable at press time. The following is a summary of his major points.

In discussing legal barriers, Mr. Huffman identified the

following aspects of western water law as important in the development of small-scale hydroelectric:

> determining whether small-scale hydroelectric development constitutes a "beneficial use" as required in the allocation of western water rights; qualifying small-scale hydroelectric development as a "diversion of water", also a prerequisite of western water law.

According to Mr. Huffman, the principal barrier in western water law is the structure of existing rights or the appropriation of senior and junior rights. Most streams today are fully appropriated, thus requiring a small-scale hydroelectric dam developer to acquire water rights. The difficulty in acquiring or transfering rights alone may preclude even the feasibility study of a potential site.

Mr. Huffman also discussed the impact of and the need for clarification of the "Public Trust Doctrine" and the "Navigability" of a stream. State statutes on minimum instream flow requirements could represent conflict of use with small-scale hydroelectric development. Additionally, the liability factor associated with dam construction and operation could be an obstacle to a developer. The impact of both of these issues, said Mr. Huffman, could be influenced by state legislatures.

DAVID AUSLAM, President, Auslam and Associates

Mr. Auslam presented an overview of the economic and financial problems of small-scale hydro, defining related procedures and issues in considering small-scale hydro projects.

He discussed the preparation of the economic and financial section of the Corps' Manual which will examine the feasibility of adding small hydroelectric power to existing facilities.

He enumerated four ways that small-scale hydro projects were different from conventional facilities from an economic and financial feasibility aspect: their low heads, single-purpose, little dependable capacity as run-of-the-river, and easier evaluation of transmission system costs due to their small ouput and availability of substations and lines.

The three major tests for determining the economic and financial feasibility of a small-scale hydro project, according to Mr. Auslam, are 1) the market analysis or the marketability of power and the value of output; 2) an economic analysis or the costs versus benefits; 3) financial analysis or the ability of a developer to pay debt service on a loan. If a project successfully passes through these stages of analyses, then a final sensitivity analysis should be performed.

Since analyses of a project cannot with absolute certainty project economic and financial conditions into the future, a sensitivity analysis should be performed during the feasibility planning phase. This type of analysis establishes the internal rate of return allowing for different project lives and energy values. Mr. Auslam maintained that existing regulatory and economic constraints severely reduce the economic and financial feasibility of a small-scale hydro project. He enumerated four major deterrants to development and offered policies for their elimination.

The marketing phase of feasibility is crucial in order to guarnantee a market and a price to stay liquid. Utilities, said Mr. Auslam, must be encouraged to purchase power and provide debt service. Although the feasibility phase presents a period of major risk, availability of funds could reduce that risk. Since the public sector has an advantage over the private in the cost of financing, provision should be made for private industry to have access to financing at reasonable rates. Mr. Auslam also recommended for small-scale hydroelectric developers the guarantee of tax exempt government bonds.

Mr. Auslam ended by citing questions most developers are asking: What are the costs involved? Who would be the purchaser? Where can financing be secured? How much profit can be expected? He suggested that the feasibility study of the marketing, economic, and financing aspects might be a possible source for answers. He said that he hoped the Small-Scale Hydroelectric Project would be developed because of the economics involved, not in spite of them.

LUNCHEON KEYNOTE ADDRESS

ASSMEBLYMAN MELDON LEVINE

Thursday's keynote luncheon speaker was to have been State Assemblyman Meldon Levine, but he was unable to attend. Mr. Brian Sway, Consultant to the State Assembly Subcommittee on Energy, delivered Assemblyman Levine's text.

Assemblyman Levine began on a positive note by reporting California's already substantial hydro development,adding that its favorable climate and topography are conducive to additional hydro development,especially small-scale hydro.

He advocated small-scale hydro as an alternate source of energy, because of the benign nature and current availability of the resource.

He reviewed some of the specific aspects of California's energy situation which makes small-scale hydro attractive to the state. Since its existing electrical generator capacity is predominantly oil-based, oil displacement by a benign source such as small-scale hydro would be welcomed.

The economic viability of small-scale hydro is also attractive to California because it represents a virtually free, escalation-proof energy source. The short lead-time for small-scale hydroelectric project development could play a strategic role in California's near-term electrical supply planning. Also, increasing utility interest reflects favorable economic conditions and good timing for small-scale hydroelectric development. The Sacramento Municipal Utility district is actively considering five projects --- .4 to 10 MW--which could be completed in 1981.

Despite these positive signs, in California and other states, major utilities are reluctant to develop large quantities of small-scale hydro, pay oil-based prices, or to purchase power from non-utility developers without assurance that their plant will be profitable.

Financing site feasibility studies presents another problem. Because most of California's potential projects are within public water supplies systems, irrigation and flood control districts, the governing boards of these agencies are unfamiliar with electric generation or utility practices, and are financially constrained by a post Proposition-13 crunch.

Three other financing issues have surfaced in California: according to Assemblyman Levine: 1) dry-year default problems, or the inability to meet principal and interest payments from climatically-limited electric sales; 2) defining the role of large utilities regarding independent water district developers; and 3) the recent IRS ruling that long-term contract power sold to private utilities or federal marketing agencies must be financed under taxable bonds. This ruling compromises small-scale hydro economics by raising interest rates.

Even with a time-constrained permit process, many time-consuming problems still remain with licensing. In California for example, the major permit problem is the water rights issue. To alleviate some of these problems the state has begun to educate key people and make funds available to expand its small-scale hydro resource: the State Energy Commission has established a feasibility study grant program; workshops are scheduled for water district personnel interested in small-scale hydro; the Commission will soon train its staff to make on-site preliminary feasibility assessments; computer model supporting arguments for cost-based resale rates before the PUC and the FERC is now operating.

Additionally, the state has proposed funding for feasibility study loans to be repaid only if projects prove workable, and has guaranteed bonds for dry-year defaults. The PUC must now require private utilities to improve marketing arrangments and optimization

of power generation has been incorporated into the state water project. According to Levine, the most crucial areas for legislative action will be in easing restrictive wheeling laws, creating loan guarantees, and designing a state water permit process for small-scale hydro.

CASE STUDY PRESENTATION

On Friday the Conference reconvened with a presentation by the staff of the Program in Social Management of Technology, University of Washington, a case study subcontractor for NCSL. Senator Hess explained that case studies are an important part of NCSL's DOE contract and will provide background information for a project policy report. They exemplify the small-scale hydroelectric development process and are used for technical assistance programs to the states.

Case studies help identify development procedures and document problems and impediments which hinder efficient planning, licensing, and constructing at different stages of site development. The Pasco, Washington site was selected by Mr. Schwartz and his staff for presentation at this conference primarily for its geographical proximity to the conference setting.

In late September case study summaries will be published for distribution. Please contact NCSL, Small-Scale Hydroelectric Project for copies.

The comments by Mr. Schwartz were especially relevant because he directed them toward the state legislators and staff. He gave an historical perspective of the river and geopolitical issues, as well as a technical description of the project. Mr. Schwartz specifically reported on the power purchase agreement, power costs, investment return , taxes and insurance, and the state regulatory constraints, which he and his staff have identified in their analysis.

The South Columbia Basin Irrigation District, Pasco, Washington will construct, own, and operate the project. Seattle and Tacoma will purchase the power output contractually for 40 years at 15 mills/kwh and obtain permits and licenses for transmission.

Regarding the regulatory constraints and costs of the project, based on information from interviews, Mr. Schwartz reported that the largest regulatory problem has been with the federal government, specifically the FERC. However, innovative financing, use of one lead-site strategy among six possible sites, and support from the state and the press have helped balance the federal constraints.

Mr. Schwartz thought that widespread use of hydro by irrigation districts in the West and Pacific Northwest might become a variable in current U.S. reappraisal of water rights and energy project policies.

Following Mr. Schwartz's case study presentation, Mr. John Warren, Project Leader, Research Triangle Institute, North Carolina, reported on the efforts of his firm as a contractor with the state Energy Institute. Mr. Warren has established a small-scale hydro information clearinghouse for potential dam developers. His program of action includes publication of a newsletter (Box 12194, Research Triangle Institute, Research Triangle Park, North Carolina 27709, (919) 541-6971), dam surveys, analysis of impact of state/federal institutional and regulatory factors on small-scale hydroelectric projects. His office also provides application assistance to dam developers.

Other efforts by Mr. Warren's office have included computerization of dam safety files with hydro potential, calculations of dam capabilities, and a hydroelectric power assessment for the North Carolina Department of Administration and the Appalachian Regional Commission.

SENATOR TED BOTTIGER

Friday's keynote luncheon speaker was State Senator Ted Bottiger, Washington. Senator Bottiger addressed four questions which NCSL staff had voiced.

1) What position on the states' energy agendas should renewable energy sources be placed?

2) What role should state legislators play in encouraging development of renewable energy?

3) What actions should state legislators take in expediting small-scale hydroelectric development?

4) How can NCSL's Energy Committee assist in the development of small-scale hydroelectric at the federal and state level?

While strongly supporting energy conservation, Senator Bottiger called for the vigorous pursuit of new generation opportunities. We must start looking for alternatives which are proven technologies and which can be brought on line in a short time, he said. He suggested that part of the answer to our future energy problems can be found by examining our past energy sources by considering energy conservation, and seeking new generation opportunities. While stimulating a new energy technology is a complex and "iffy" task, the Senator noted that small-scale is a proven, off-the-shelf technology which is at a commercialization stage in its development.

Considering the role of state legislators in facilitating renewable energy development, Senator Bottiger pointed out that each developer faces a different set of legal and institutional constraints and economic challenges. Easing them would be an appropriate focus for legislative action. Senator Bottiger advocated surveying the state's resources and broadly disseminating that information.

Senator Bottiger responded to the third question by citing specific legislative action already taken by his state of Washington.

which eventually removed a financial barrier for irrigation districts and permitted them to issue long-term revenue bonds and enter into long-term contract sales. Senator Bottiger described Washington's Energy Facilities Site Evaluation Council and urged other states to adopt a mini-version for small-scale energy options.

Concerning the role of NCSL's Energy Committee in small-scale hydroelectric development, the Senator recommended that states share information and experiences with NCSL as the conduit for that exchange.

Finally, Senator Bottiger thought that improving inventories where viable small hydro sites are located and distributing that information to more potential developers would be valuable.

WORKSHOPS

During the Workshop Recommendation and Summary Session facilitators reported on their group discussions and offered policy recommendations developed by the conferees. It appeared that most of the groups focused on topical problems, but a number of substantive policy options were suggested. The most significant recommendation made concerned the need for standardized environmental review and reporting coordination by federal and state governmental agencies. State energy facility site evaluation councils, state lead agencies, establishment of negative declarations, implementation by state PUC's of PURPA provision, deletion of rate of return regulations, creation of one-stop licensing, tax-exempt financing for sale of power, federal/state guarantees of revenue bonds, were all recommended by the conferees.

The FERC streamlining efforts were characterized in one group as only "less long" and representative of "Potomac Barriers." a reference to federal obstacles. Discussion emphasized the regional power issues and aspects of energy development.

It was interesting to see little concern expressed regarding the need for and the cost of fish ladders, and the difficulty in acquiring and/or transferring water rights.

RESOURCE PRESENTATION

THINKING SMALL MAY BE THINKING BIG

Sterling Munro
Bonneville Power Administrator

On my daily drive to work, I sometimes listen to a radio station that broadcasts Dale Carnegie's observations on making the most on one's self. He deplores undeveloped human potential. How much potential in all humans to do great things, he exults! But, oh, how little of that capacity ever gets developed, he bemoans. And what a waste for it to go unused, he sighs.

Well, that's pretty much the way I feel about small-scale hydro. From your sponsorship of the Small-Scale Hydroelectric Policy Project, I suspect you may feel the same way. So I applaud your efforts to identify the barriers to development, to document case histories, to develop a model program for state legislatures, and to seek answers and public support by sponsoring regional conferences such as this.

Your project director has asked me to focus on three questions: (1) Will BPA have a small-scale hydro program in the coming months? (2) How does BPA view the development of small-scale hydro as an energy source for the Northwest? (3) Who and what role can BPA staff play in assisting state legislatures to develop small-scale hydro programs? I shall address all three questions, but not in that order. I should like first to treat the second question, the one concerning BPA's view of small hydro as a regional resource -- small hydro being defined as projects with capacity of 15 megawatts or less, although the House is reported ready to act favorably on legislation sponsored by Senator Jackson and passed by the Senate that, for the purposed of Federal financial assistance, would change the definition to 25 megawatts or less. Then I should like to combine and answer as one the questions about a BPA small hydro program and the who and what of how BPA can help state legislatures promote the development of small hydro projects.

Already I have said that I feel about undeveloped small hydro potential the way Dale Carnegie does about undeveloped human potential. A feeling of let's do something about that undeveloped potential! And the same could be said about solar potential . . . and wind potential . . . and biomass and cogeneration potential . . . and about all the other renewable resource potential presumably just sitting out

there waiting to be developed. And I feel the same way about conservation, which must be considered a resource, too, along with large or small-scale hydro and conventional or renewable resources.

When looking at the potential of conservation or renewable resources, be it small-scale hydro or solar or whatever, we find that the realistic conservation savings or power generation that can be expected to come from any one project or source is relatively small. That is, there aren't any 1000 megawatt blocks of conservation or renewable resources out there. But there are so many small prospects that, altogether, they can add up to a large amount. So, in seeking to develop the potential of small hydro -- as with small-scale projects utilizing other renewable resources -- we are panning for gold dust, not looking for nuggets. But there's also a lot of fool's gold in the streams where we are doing the panning!

For example, let's not get overly impressed when we hear there are 39,000 megawatts of small-scale hydro potential in Washington, Oregon, Idaho and Montana west of the Divide -- as reported by the Water Resources Research Institute of each of those states. Because, after allowing for all the restraints on small hydro development, the realistically attainable small hydro in these four Northwest states may amount to a mere fraction of the potential. That's how it turned out when the Oregon water resources people and their Washington and Idaho and Montana counterparts completed their preliminary screening of the potential sites. When Oregon's Water Resources Research Institute had finished considering the irrigation and fish and other existing uses that must be protected . . . the environmental concerns . . . the transmission distance and expense in relation to the output of a small project . . . the rural or town populations that would have to be moved . . . and the other restraints . . . Oregon's highly-publicized 6,000 to 12,000 megawatts of small-scale hydro potential became 227 megawatts to 413 megawatts depending on whether the power was to be available 50 percent of the time or only 30 percent of the time. The Oregon people who had measured a theoretical potential of thousands of megawatts found a realistically attainable potential of a few hundred -- a realistically attainable potential equivalent not to five nuclear power plants, as widely publicized, but a fraction of one.

So it was in Washington, Idaho and Montana. Their water resources people tell us that each state's much publicized theoretical potential measured in the thousands

of megawatts has a realistically attainable potential that must be measured in the hundreds.

Instead of being discouraged by these real-world realities, let's be happy for the potential that can be developed. Let's find ways to do it.

The President, in his recent solar energy messages to the public and the Congress, set as a goal for the nation to be producing 20 percent of its total energy consumption by means of solar and other renewable resources by the year 2000. He said that 6 percent of the nation's present energy consumption is provided by those means, mostly hydro. In our region, of course, 45 percent of all the energy we use comes from hdyro. We don't use more energy per capita than other regions, but more of what we do use is consumed in the form of electricity -- 53 percent at last count. Although our region is getting more heavily into thermal power, about 85 percent of the electricity we use is still hydro. Simple arithmetic shows, then, that 45 percent of our region's energy comes from hydro, compared to 6 percent of the nation's energy coming from hydro and solar and other renewable resources. We are ahead of the President's goal for the nation, but because so much of our hydro already is developed, we will have to work hard to stay ahead. On the other hand, our already developed hydro gives us a big lead on developing other renewable resources. Many of the renewables produce power intermittently and require back-up and load-shaping. The Columbia River system can provide the storage to make the intermittent production of some renewable resources more dependable and therefore more marketable, more useable. In short, the hydro system we already have in place may put us in a position to lead the nation in developing solar and other renewables.

It doesn't help just to say there's 12,000 megawatts of potential in Oregon, if nobody is allowed to build any dams. But it does help, I think, to say there's 6,000 to 12,000 megawatts potential, if we also say but we're going to have to go all out to get even a few hundred megawatts developed, in our lifetimes, considering all the restraints. Maybe I should add, "and only if we live a long time." Even if some among us think more is attainable, let's not get hung up arguing that point. Maybe everything that has been ruled out as a result of preliminary screening shouldn't have been. Maybe people will be willing to pay a higher environmental or economic price for small hydro than they are now. But that is not the point. The point is to get busy doing what is now attainable, and then push for more if

indeed more becomes realistically attainable. That's how the big-scale hydro got developed -- one at a time, the best sites first, the lesser and less-agreed upon sites next, then the more marginal sites, until there came a point where not enough people were willing to pay the economic or the environmental price.

Conditions may be changing to favor more hydro development in all sizes, large or small. The special advantages of hydro have to be adjudged pretty compelling as we reassess our energy options. It is a domestic resource that doesn't add to our oil imports and balance of payment problems. It is relatively inflation proof. Fuel costs are zero. It is clean, safe and as renewable as any form of energy. Assuredly, a good portion of the hydro potential across the land that has gone undeveloped for environmental or economic reasons may, on being given a new look, be judged feasible. Nevertheless, those aren't all hazzahs I hear for the Ben Franklin or Asotin sites now that serious consideration of those two undeveloped big sites has been resurrected by the Corps in the first instance, and a group of cooperatives called the Pacific Northwest Generating Co., in the other. And just a couple of months ago, I read that in California protestors chained themselves to rocks in the reservoir area of the newly constructed Mellones Dam to stop filling of the reservoir and prevent what they viewed as ruination of the Stanislaus River and white water canoeing.

I don't know that feeling would run that strong against small-scale hydro, but I do know that for specific sites there are various degrees of enthusiasm among different interest groups. I also know that among would-be builders there are varying degrees of hope and expectation -- and varying degrees of interest, too, considering the realities.

One of the realities is that after each state's Water Resources Research Institute, or the Corps or the Bureau of Reclamation or the DOE or somebody else, identifies the potential sites, a feasibility study must be made by somebody. That's true whether for a previously undeveloped site or one developed for some other purpose with a dam in place just waiting for someone to add generators. That takes time and money. BPA's small-scale hydro resource assessment team -- one of six resource assessment teams we have established to look into many types of potential future resources -- tells me a feasibility study for a small hydro site can easily chew up $100,000 and that the average is between $30,000 and $40,000 for feasibility studies for typical small hydro projects recently completed or underway in this region.

Out of the 1,443 stream reaches identified by the State of Oregon's Water Resources Research Institute as having potential for small hydro, only 56 --- 56 out of 1,443 -- survived preliminary screening. That leaves 56 sites that might be developed. But that also leaves 56 feasibility studies to be done -- by somebody -- at a cost of $30,000 to $40,000 each, on average. That's a lot of money for any utility -- especially a small utility -- to expend on a small-scale hydro site when you consider that, for other than the very small projects under 1½ megawatts, come licensing time the same long, drawn-out licensing procedure must be faced as for big hydro sites. In addition to obtaining state and local permits and licenses, non-Federal utilities wishing to develop small hydro projects must obtain Federal Energy Regulatory Commission (FERC) permits and licenses. FERC recently issued revised permit/license requirements to comply with the President's request to simplify Federal licensing procedures, but these revisions have met opposition from the environmental community. The public review period has passed, but FERC has not yet chosen to implement these new procedures. And while efforts to simplify licensing procedures are stymied or delayed at one level of government, new rules and regulations that complicate the procedure are adopted at other levels.

For example, the Oregon State Energy Facility Siting Council just a month ago adopted a rule identifying 51 plant species and 8 animal species which, if threatened by a power plant, would require rejection of the site. I'm not saying these endangered species shouldn't be protected. I am saying it makes it even more difficult to get approval of a small hydro site, or any other kind of power site, in Oregon. There will be more rules and regulations of this type, and not just in Oregon, I am sure -- and applying not just to small-scale hydro, but to all kinds of alternative energy resources that people <u>say</u> should be more acceptable than the conventional projects that have encountered so much trouble.

You will forgive me, I hope, if I appear somewhat skeptical about the degree of deep-down support for renewable resources. I freely confess to harboring some doubts about the ease with which we will be able to make the transition into the world of new and renewable resources. My own slightly skeptical view is that power plants of any type and new power technology of any type are acceptable in inverse proportion to their readiness for constructiom or implementation -- the closer at hand, the more unacceptable. When a site specific project is ready to go, you can count on it, somebody will object. You know that is true of nuclear and coal projects. But did you know that in Idaho, the other day, one of the editors of the

Lewiston Tribune was stopped in an effort to install solar heating on her new house by neighbors who claimed the solar panels would be unsightly. Local codes permitted the neighbors to prevail. Elsewhere, happily, that is not the case. But no wonder the Lewiston paper editorialized: "We can harness the sun, but will we?" And did you see where the Portland Oregonian editorialized a few weeks ago on the health hazards of particulate emmissions from wood stoves! The Oregonian cited a recent study by the Oregon Department of Environmental Quality. So, let's not think the transition will be easy. It will come. It just won't be easy.

For all the potential small-scale hydro sites identified and already preliminarily screened by the Water Resources Research Institutes of the four Northwest states, feasibility studies are underway on very few. That is true even though the Department of Energy is now offering low-interest loans up to 90 percent of the cost of feasibility studies and up to 75 percent of the cost of construction on sites found feasible. It is true even though the Corps of Engineers and the Bureau of Reclamation can still be given authorization and appropriations by Congress in the time-honored way for getting multi-purpose river development feasibility studies done and actual construction accomplished. In fact, BPA's small-scale hydro team can find only about a dozen feasibility studies recently completed or underway for small-scale hydro projects, half of them funded by DOE. So let's give a cheer for the Warm Springs Indians and the South Columbia Irrigation District and the City of Spokane and others doing feasibility studies with DOE assistance. And let's give an even bigger cheer for those doing them without Federal help -- from little Lincoln Electric in Northeastern Washington, which is trying to develop a 3 megawatt project on the Kettle River, to the three Columbia Basin Irrigation Districts, which are working with the big municipal systems of Seattle and Tacoma to develop 5 irrigation canal sites ranging from 2.2 megawatts to 14.5 megawatts as well as one canal site with 72 megawatts of potential. One project I am watching with special interest, because it's near my home in Wenatchee, Washington, is the one sponsored by Chelan County PUD which has applied to FERC for licenses to build two small hydro plants of 4 megawatts each on the Wenatchee River. At Bonneville, we're also cheering the efforts of the Clark County and Skamania County Public Utility Districts to develop up to 37 megawatts of peak power on the Little White Salmon River, a project BPA had viewed as only marginally feasible and of low priority when first proposed by Skamania in 1964. We hope this will prove to be a prime example of how hydro feasibility improves with the passage of time.

Well, short of completion of our small hydro team's forthcoming evaluation, I hope I have made clear how BPA presently views small-scale hydro as an energy source for the Northwest. We see it as having small potential relative to overall regional needs, beset with many problems but feasible in many cases today where it was not feasible in years past, and important -- nay, vital -- to develop to the fullest extent possible. I say vital because I do not think we can afford to overlook any available resource that is economically and environmentally feasible, especially a renewable resource, no matter how small. In China, I saw use of hydro projects producing as little as 12 kilowatts - kilowatts, not megawatts -- enough to power just a few light bulbs. China has 60,000 or more small hydro generators putting out time amounts of electricity but making a valuable contribution to total supply in energy-poor China.

You can count on me as part of the "small is beautiful" crowd . . . provided. My proviso is that we also must be willing to develop the larger scale projects, including those utilizing conventional resources, to the extent necessary if -- after factoring in all feasible and cost-effective conservation -- we find that all the small and renewable projects we are able to develop are not sufficient to meet people's needs.

One of the special problems for small-scale hydro is that as a rule it produces very little firm power. Usually, it utilizes run-of-the-river streamflows without the benefit of storage, and it must be integrated with a large system that can provide the emergency back-up and load-shaping. Bonneville and the Federal Columbia River Power System now provide the load-shaping, as we call it, for many of the 61 small -- under 15 MW -- hydro plants already existing in the region. How much more backup the Federal system can provide we cannot answer precisely at this time. It is one of the things our resource assessment teams will try to determine.

Bonneville presently is limited to participating in planning studies and to enhancing the marketability of intermittently-produced small-scale hydro energy by storing it in the form of water in Federal reservoirs, advancing energy, load-shaping to the extent we can and, to be sure, providing the necessary transmission. Marketing opportunities, of course, are ultimately determined by price. With the estimated cost for electric power from large thermal power plants after 1985 in excess of 30 mills per kwh, maybe in excess of 40 mills, small-scale hydro could be very price competitive. We shall use our imagination and ingenuity to try not to

overlook any practical means to market this intermittent but renewable resource.

BPA, as you realize, does not have a so-called "utility responsibility" although, because of our efforts to encourage proper planning to meet the region's needs, we frequently are accused of acting as if we thought we did. But the fact is that we have no legislative mandate to assure that sufficient power is available to meet the requirements of homeowners or other end-use consumers. That is the responsibility of the utilities which serve the end-users. Under existing law, we simply market Federal power, selling it at wholesale with preference to publicly owned utilities and cooperatives and -- to the extent available -- to Federal agencies, industries and investor-owned utilities as well. Such power now consists of the hydro produced at large Federal multi-purpose dams built and operated by the Corps of Engineers and the Bureau of Reclamation, plus certain amounts of thermal power which we are acquiring under net-billing arrangements approved by Congress. The Corps and the Bureau are building very little new generation these days, and BPA for all practical purposes reached the limit of its net-billing capability some time ago. So not only have we had to exercise our contractual rights and give formal Notice of Insufficiency to our preference customers as regards our ability to meet their full requirements after 1983, but we are quite limited now as to what we can do to assure development of small-scale hydro -- or anything else in the region.

We would like to be able to do more. Specifically, we would like to have the authority the proposed regional power bill would give us with respect to conservation and renewable resources. As for the latter, the bill would allow us to acquire the output of small hydro and other renewable resource projects constructed by others. The bill would not authorize us to construct generating facilities, and we do not seek such authority. The authorization for BPA to acquire power generated at projects built by others would be a powerful stimulus to the development of the maximum feasible and cost-effective small-scale hydro projects and other renewable resources. It would, in effect, put the equity of the Federal Columbia River Power System behind the financing required by whomever were to build the projects. This, combined with the assurance of a market for the power, would bring lower interest rates and lower power costs than otherwise possible, and distribute both the costs and the benefits throughout the region.

The priorities contained in the pending regional power bill also would tend to

assure maximum development of the attainable small-scale hydro potential of the region. The bill would establish a regional planning process for review of the utility forecasts of future needs and to make sure that non-utility input is given consideration in the region's final assessments of needs. This same regional planning process would then determine the ways in which the needs would be met -- conservation, solar, wind, hydro, nuclear, coal, oil, whatever. But the bill does not leave it entirely up to the regional power planners to determine what resources would be employed to meet the projected needs. The bill would establish priorities. Conservation would come first. Then renewable resources, including small-scale hydro. Then and only then could nuclear or coal or other conventional resources be added to the mix. The region would proceed on all three tracks simultaneously, if necessary, but conservation and renewable resources to the extent feasible and cost-effective would be factored in first. But I remind you, under the bill BPA could not develop these resources -- we would be only a potentially willing purchaser of power. Some utility or other entity must stand ready, willing and able to build the hydro project.

By authorizing BPA to purchase the output of plants built by others, and by assigning priority to renewable resources ahead of conventional, the bill certainly would make BPA a much stronger force to assure maximum feasible development of small-scale hydro. And so would Section 210 of the Public Utility Regulation and Policy Act (PURPA). Section 210 requires FERC by November 9 this year to prescribe rules to encourage cogeneration and small power production, defined to include hydro projects under 80 megawatts at existing dams. This will have the impact on BPA of further encouraging us to exchange energy from such power production facilities for energy from the Federal system -- thereby effecting the load-shaping and firming of power I spoke of earlier. After FERC adopts these rules, the State regulatory commissions in the case of regulated utilities, and the utilities, themselves, in the case of non-regulated utilities, must provide for implementation of the FERC rules. That means BPA necessarily will develop an implementation policy. If Section 210 is effective in encouraging more sponsors to undertake such projects, as I hope and expect it will be, BPA will stand ready to perform its PURPA role.

So the potential exists -- there's that word "potential" again -- for BPA to act as more of a catalyst then heretofore in this region for development of small-scale hydro and conservation and other renewable resources. The proposed regional power bill would give a push to development of economically feasible resources by

giving BPA purchase authority, and PURPA would give an additional push by the Section 210 provisions permitting more generous assessment of economic feasibility as well as by the provisions already in effect allowing DOE to make loans for feasibility studies and construction of small hydro projects.

The extent to which BPA can play a role in development of small hydro and conservation and other renewable resources thus is still being shaped at the Federal level. Innovative state undertakings might provide us with more opportunities. Meantime, we are doing the things I have described, and intend to do them with increasing vigor and vitality.

You will find us more eager than ever before to put our people to work on load integration studies and marketing studies and preparation of other kinds of data that would assist the regulatory commissions and legislatures of the States to advance small hydro and other renewable resource development. We don't want Dale Carnegie or anyone else to deplore that Bonneville might not be living up to our potential for seeing that small hydro and other renewable resources and conservation are developed up to their potential. We would even like to be invested with some more potential to have to try to live up to.

ENVIRONMENTAL OVERVIEW OF SMALL-SCALE HYDROELECTRIC POWER

Richard Cellarius

Sierra Club

The organizers of this conference have given me a fairly straightforward assignment - what are all the good and bad things about small-scale hydroelectric power from an environmental perspective? This is no small task to do in fifteen minutes. I'd like to start by asking you to take a hard look at an initial question! Is there a need? If so, how great is the need? One cannot deny that the Pacific coast and especially the Northwest is experiencing a major influx of people and industrial growth -- as folks flock here to avoid the debacles of pollution of both air and water, the degradation of cities and suburbs and the general deterioriation of the natural environment by human developments. In our eagerness to accept all the new tax revenues they bring and to develop new incentives to keep 'em coming, we need to realize that it would be a mistake to go to such extremes that we lose one of the major assets that attracts them -- and has attracted many of us -- in the first place, the scenic grandeur and other natural resources of the Northwest. And I will admit that I too am an immigrant from California. In fact, we're all immigrants, aren't we?

So as we consider this technology, my first point is this: let's not give away too much. I'm reminded of a story I first heard from a college classmate of mine over 20 years ago. A little old lady was driving along the highway in her shiny new Volkswagen and noticed another little old lady stopped by the side of the road with the hood up on the front of her shiny new Volkswagen. The first little old lady pulled over and asked what the problem was. "Well", said the second, "Look, It seems that I've lost my motor". "Oh", said the first, "You're lucky I came along. We can fix that easily. I've got a spare in my trunk". As we attempt to develop our energy resources, what illusions do we have for the sources of our spare!

But folks are coming, aren't they? Even with conservation measures, immigration of people is going to continue to create demands for more energy. For the Northwest, that has traditionally meant electricity, especially hydro power. I won't go further into the issue of how much growth will occur or the policies necessary to reduce the growth -- you get that all too frequently already. But please don't look at small-scale hydro development -- or any other energy source -- as an out. No matter how benign they appear in comparison to other sources, all energy developments have adverse environmental and social impacts as well as beneficial ones. The whole philosophy behind the Environmental Impact Statement process is to subject the impacts to public review and to have the analysis be an integral part of the decision-making process.

Our energy choices now are societal choices; by that I mean they really involve political and social issues, not technical questions for the most part. Therefore, it is very important that the decision-making process be an open one. The more participation in and information about the process, the more likely will be the probability that the folks who must finally live with the choice will at least accept the decision. I strongly recommend the development of citizen advisory councils to work with those doing the planning and feasibility studies, starting as early as possible in the developmental process. Don't rely only on standard public notice publication to get them involved.

Let's get down to specifics. Hydroelectric power is essentially a renewable resource; it depends ultimately on solar energy. There are some impacts, of course, due to both installation and operation of a facility. I'd like first to review briefly a few of these problems in a generic sense before discussing specific types of small-scale projects. Many of these impacts are obvious and you've heard them before. Many of them will be minor problems for small-scale developments. But there are a few points that I've only recently become aware of, and I'll put a little more emphasis on these, in anticipation that they may be new to you as well.

The most visible effects of any hydroelectric project will be on the land itself. Many potential sites are in wilderness areas, in de facto roadless areas, or in wild or scenic river corridors. They may have historic and archaeological significance. These will have legal or political barriers to their use. But such preserves should not be the only concern. We are also losing prime commercial forest land and agricultural land to development at an alarming rate. Some of the best sites for growing such crops are in river valleys and floodplains which are prime candidates for new or enlarged dams. There must be careful weighing of the relative benefits and losses before a decision is made to sacrifice one product for another.

And let us not forget the impact of the transmission corridors. A 20-50 mile-long, 100 foot-wide transmission corridor might be the worst part of a project. Are there less visible and less destructive alternatives that might save an otherwise viable proposal?

In the analysis of the impact of a project, there is also a real danger in overinflating its value by including what may be specious or deceptive recreation benefits. One more lake to run motorboats on may not be an advantage at all. And how much energy will be utilized by folks driving to this new recreation site and then running their motors on it? If we are talking about small-scale developments, maybe a significant portion of the energy made available will be expended for recreation. The total energy picture must be considered, not just well-chosen pieces.

The second set of impacts will be on the water quality. Setting the fisheries impacts of water quality aside a moment, dams disrupt natural siltation and nutrient patterns. This not only results in problems behind the dams, but can have a deleterious impact on the vegetation communities downstream that develop as a result of the available nutrients and silt brought in by the stream flow and periodic floodings. The temperature fluctuations and extremes due to impoundments are likely to be quite different from the free-flowing stream as well. There are also major problems of oxygen depletion in impounded waters as the organic matter decays. This is a relatively short-term

effect, but could have long-term implications if it disrupts the natural processes downstream and the ecological system changes as a result.

The impact on fisheries resources should be, perhaps, the greatest environmental concern over hydropower here in the Northwest. It may not be much of one any more, however, as we have apparently already lost much of our natural fisheries. It is not just the physical barriers of dams and turbines that the fish have to deal with or the loss of spawning grounds, if they could get there. We need to know even more about the biology of the fish. I just recently learned that salmon fingerlings migrate down to the sea tail first. That is, they are physically carried down stream by the flow, not swimming downstream. When this flow isinterrupted by a lake, for example, the probability of the fingerling reaching the sea is considerably lessened.

Regulated flow patterns are also out of phase with natural flows that fisheries need. In the spring, the run-off from melting snow is trapped behind the dam, rather than facilitating the spring migration. And in late fall, when natural flows are low, regulated flows begin to increase as folks demand more energy for heating, etc. and it is more difficult for the fish to get upstream to spawn. So even with fish ladders and screens over turbines, the fisheries are still severely interfered with. And the smaller the stream, the more critical the flow requirements may be.

I mentioned earlier that dams disrupt nutrient and siltation patterns and water temperature. Another result of this is the disruption of food webs and thus food supplies for resident species. There is a great deal of documentation of complete changes in the nature of the fish community when a dam is constructed.

At a recent meeting, a group called the Columbia River Citizens Compact , was formed to work for protection and recovery of natural resources in the Columbia basin. Two principles of their "Compact" are particularly relevant here: "(1) Fish and wildlife shall be entitled to equal rights with power, transportation and agriculture in the consideration of any proposed project; (2) Legal protection

shall be provided for optimum flows, as distinguished from minimum flows, for fish and wildlife on every occasion when a public water right is to be established or recognized."

Recently the federal Departments of Interior and Commerce jointly issued proposed regulations designed to strengthen compliance with the Fish and Wildlife Coordination Act. Views of state and federal wildlife agencies must be taken in to account, consultation must take place at the earliest planning stages and there must be public participation throughout the decision-making process. It is an encouraging sign that at the federal level, at least, fish and wildlife conservation would be given equal weight to economic and other projected costs and benefits.

One point here needs emphasis. The concerns about potential problems should not stop with the construction of the project. Even with small-scale developments, we need strong and enforceable regulations on operation. Optimum flows must be maintained. A good project can become very destructive depending on how it is managed. Specification of the necessary controls must be part of the planning and environmental analysis process from the beginning. And we must resist the temptation to relax them for convenience or economic reasons at a later date. One of the most environmentally destructive forces in existence in the government today is the "variance". It ought to be prohibited, without variance!

I would now like to review the various types of small-scale hydroelectric development and test them against the problems I've just outlined. As I understand it, there are about four suggested ways to develop small-scale hydro: refurbishing existing small power dams for greater efficiency or generator capacity; installing generating capacity in facilities originally constructed for other purposes such as irrigation, water supplies, flood control, etc. (retrofitting); construction of new dams; and finally, the installation of a bulb turbine system with a diversion pipe directly in the stream without any dam construction at all.

Refurbishing and/or installing generating capacity on already existing dams makes a great deal of sense, and these are likely to have minimal environmental impact over whatever impact has already occurred through the original construction. I do have a few cautions. In a few cases, refurbishing may mean dredging years of accumulated silt, and disposal of the silt could become a problem. If one was generating on a stream-flow basis, rather than relying on the dam for wet to dry period storage, however, then silt removal might be avoided. In the case of installing generating capacity on dams originally constructed for other purposes, there may be serious conflicts between the periodic flow demands for power production and those for the original purpose. Such conflicts need to be examined because power production may not be practical or economic if the project is constrained to operate on somebody else's schedule. The construction of new transmission lines could also create major problems.

The construction of new dams or raising the height of existing ones are perhaps the most critical alternatives. They will also require the most stringent examination of environmental impacts. There are many sites that cannot be utilized because of preserve designation. There are others that should not be and would be opposed by a large number of environmental and other groups. Fisheries, wildlife and land-use concerns would predominate here. There may be other sites, however, that could be acceptable if planning were done properly. I have seen some suggestion, incidentally, that a trade-off might be made for the destruction by a new dam of a natural fishery, by constructing a fish hatchery as replacement or instituting more direct management of the fish run, etc. To me this is a dangerous game to play, both from an aesthetic and biological point of view. There is still a lot we don't know about fisheries' biology. I just saw a news report about a study being made at the University of Washington where they are experimenting with conditioning salmon by forcing them to swim in an artificially generated stream so they can get strengthened by exercise -- the man-made substitute for natural stream flows. It make about as much sense as all those folks who go out for their jog around the block and then climb into their gas

guzzler for the five-minute drive to the store or the office. And what are we doing to the richness of natural gene pools and their response to environmental change as we artificially culture only a few selected stocks and exterminate the rest? Preserving natural gene stocks is fast becoming a major concern of resource biologists.

The final method is the no-dam one -- installation of a turbine and generator system depends only on the flow of the stream using a diversion pipe. I find this an intriguing idea. It can certainly eliminate many of the potential problems created by impoundments. My main concern would by how much of the natural flow of the stream would be diverted through the turbine. Even over short distances this could create real problems for natural fish runs. This would not be a problem of course in irrigation canals.

Now that I've given this long laundry list of potential problems, let me emphasize that these are potential problems and they may only be critical for a limited number of otherwise attractive sites. My purpose for going through them is to try to convince you that a thorough analysis must be made of every site. In your discussions during this conference, you will want to find ways of expediting dealing with the environmental and other requirements that must be met. But please don't make the mistake of trying to find ways of circumventing these requirements. Keep in mind one of Francis Bacon's aphorisms: Naturae enim non imperatur, nisi parendo (We cannot command nature except by obeying her.) The environmental analyses required are there to help us learn how best to obey natural laws -- for our long-term benefit.

Before concluding, I need to add one other important point. There are undoubtedly a number of attractive sites for small-scale hydroelectric development which will meet the environmental and other social, political and economic requirements. These need to be identified early in the planning process, with full public participation, as I mentioned earlier. But in addition to a site by site analysis, there should also be a programmatic analysis, that is, a review of how many sites are likely to be developed and the overall impact of

developing all of them. Any given project may by itself have little impact, but the cumulative impact within a watershed, across watersheds or even within larger ecological regions, could be large. I would suggest that such programmatic analyses be done on a state-wide basis, at a minimum, and on a regional basis in the case of the Columbia basin. The analyses should be done by bodies that to not have a role in promotion small-scale hydro, so that they can be done as critically and objectively as possible. Environmentalists learn fast to demand programmatic analyses as they see environamental quality nibbled away project by project.

Small-scale hydroelectric development certainly does have an important place in the overall list of renewable energy sources. I personally would put it relatively high on the list of priorities to consider -- after conservation, of course, including mandatory measures, not just voluntary ones. Most environmental organizations do not have a specific policy on small hydroelectric developments, but they are concerned about the loss of any more of our free flowing streams. Few of us have a good sense of just how small a project can be and thus have minimal environmental impact, but still be practical. The possibilities are intriguing, and certainly seem more attractive than either nuclear or coalfired thermal plants. We need to know a great deal more than we do now, and I'm pleased that there are some comprehensive studies being done. I suspect the actual total power available is relatively small, however, and small-scale hydroelectric power is no more of a panacea than anything else. We all thought nuclear power would be our salvation -- and in fact there was a time when most environmentalists supported its development. But we've learned a lesson, I hope, and we need to look at every proposal with a good strong dose of skepticism.

So that is my basic message: Do the site studies -- our concerns are going to be primarily site specific -- and do them well. Keep the public involved from the start. Trying to resolve problems early could go a long way to eliminating conflicts and expeding the approval process.

THE ECONOMICS AND FINANCE OF SMALL HYDRO POWER DEVELOPMENT

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INTRODUCTION

The recent world energy shortage has increased interest in the direction of renewable energy sources. The focus of this conference is on the oldest widely utilized of these sources -- small-scale hydro. The focus of this presentation is on the economics and finance of small-scale hydro development.

I will address myself to presenting an overview and definition of procedures and issues related to economic and financial considerations in planning small hydro power projects, and an identification of the key problems or issues and possible policy courses that could be implemented in their solution.

AUSLAM & ASSOCIATES' ACTIVITY IN SMALL HYDRO

In coming months, we will be involved in the Rural Development Initiatives-Energy for Rural America Program, initiated by President Carter, which is anticipated to contain a significant level of funding for small hydro development in the United States. It is planned that the program by mid-1979 will have nominated 750 potential small hydroelectric sites, conducted 250 reconnaissance studies by October 1979, completed 100 feasibility studies by October 1980, and will eventually provide funds for construction for those projects deemed to be feasibile by January 1981. The program hopes to add 300 MW of additional capacity by the mid-1980's.

OVERVIEW OF THE ECONOMICS AND FINANCE OF SMALL HYDRO

Uniqueness of Small Hydro

Small hydroelectric projects differ from existing conventional hydroelectric facilities in four significant ways important to economic and financial feasibility analysis. First, most small hydroelectric projects have relatively low heads (less than 100 feet). Because turbine and other powerhouse costs

are more closely correlated to flow than head, the per kilowatt (kW) cost of powerhouse, switch yard and other miscellaneous equipment can be relatively high.

Second, the analysis of small projects is usually conducted in the context of a single purpose, nonessential project. The decision to construct or not construct generally will be based solely on the benefits versus the costs of power production. This is in contrast to many major multi-purpose projects justified on flood control, recreation and other benefits in addition to the value of power.

Third, most small hydro projects have little working storage dedicated to power production. This will simplify the operational plan of the project and will also result in the nature of the project's power being different than in most power projects. In the typical small project with little or no storage, there is no ability to store water and schedule peak power generation. Consequently, the project is run-of-the-river, with little, if any, dependable capacity.

Fourth, the cost of service of large hydro projects will include the transmission system to a substation capable of handling a large power input. In small hydro projects with much small power output, transmission line costs should typically represent a lesser portion of the total project costs because of the availability of substations and transmission lines that can handle up to 15 MW of additional input. Because of this, the treatment of transmission system costs and losses will be easier to evaluate.

Determination of Small Hydro Economic and Financial Feasibility

The three major components of determining the economic and financial feasibility of a small hydro project are the market, economic and financial analysis. This begins with a market analysis which flows to the economic analysis, which flows to the financial analysis. If a project proves feasible through the financial analysis, sensitivity analysis should be performed on the project.

Market Analysis - The market analysis is performed to determine the marketability of power and the value of the output. The major potential markets are

public and investor owned utilities and private industrial users. The value of a small hydro project is determined by the power purchaser's opportunity to reduce existing costs while maintaining equivalent service. For utility purchasers, we have found that the most accurate way to estimate the value of the output is to determine the amount of time that each generation type is the most expensive energy source that small hydro will displace. In this way, small hydro would be replacing the marginal energy source. In most cases gas turbines are the marginal source.

Economic Analysis - The economic analysis is deemed positive when project benefits exceed project costs. Since small hydro projects are usually single purpose (comparing the cost and benefits of power production) and are typically for an investor, an internal rate of return is most often used in evaluating the benefits and costs of a small hydro project. The internal rate of return shows the expected profit in percentage terms.

The federal government convention is to assume constant price levels when evaluating the costs and benefits streams for a project. We feel that general price escalation and resource cost inflation is a must and we have proposed to the government that this be done. In evaluating projects, the utilities always utilize general price escalation and resource cost escalation. We feel it should also be done for small hydro.

Financial Analysis - Financial analysis is to determine if financing can be found and if revenues sufficient to provide debt service to the project can be generated. A positive financial analysis must show that the project is self-liquidating with acceptable risk at realistic rates.

The sources of project financing are principally the federal government, public utilities, and investors. The federal government, mainly through DOE, is currently setting up a loan program which President Carter has decided to push. We are closely following the developments in this area so that we can aid in preparing loan applications when the program becomes reality.

Public utilities can finance projects through general obligation and revenue bonds. Investors can finance projects through bonds, warrants, stocks, and long- and short term debt.

Sensitivity Analysis - The analysis of any project cannot project economic and financial conditions into the future with absolute certainty. For this reason, we normally perform sensitivity analysis at the feasibility level. This sensitivity analysis looks at the internal rate of return, assuming different project lifes and energy values. Sensitivity analysis provides, for the investor, a gauge for the relative risk that he can expect by undertaking small-scale hydro development.

ECONOMIC ISSUES AND POLICIES FOR SMALL HYDRO DEVELOPMENT

The probability of a small hydro project proving to be economically and financially feasible is greatly reduced by existing regulatory and economic constraints. Some of these constraints exist because of the capital intensive nature of small hydro and some because of existing laws and regulations.

In our experience, we have run into several key economic or financial problems which can be expected to deter the development of small hydro. We feel there are four major areas. These four major issues and selected policies for their solutions are:

Issue 1: The marketing phase of feasibility is very difficult and important. Projects must have a guaranteed market and price so the debt can be serviced.

Policy:
a) Institute clear guidelines and standards for determining the value of power produced.
b) Influence and encourage utilities to purchase power and provide debt services for the project.

Issue 2: The feasibility stage is a period of major risk. All project expenditures are subject to total loss.

Policy: Provision of feasibility funds to reduce risk to acceptable levels.

Issue 3: Project feasibility is sensitive to the cost of financing with the public sector at an advantage over the private sector. This is not so much in the West as in the East since a majority of projects in the West are public or quasi-public.

Policy: Provision for private access to financing at reasonable rates.

Issue 4: Tax exempt bond status not available except to public sponsors who do not sell to IOU's.

Policy: Guarantee tax exempt status of government issued small hydro revenue bonds.

SUMMARY AND CONCLUSIONS

In summary, I have talked about the marketing, economics and finance of small hydro. In addition, I have identified key issues and policies for small hydro development. We have found that the key questions that developers ask are:

- How much will it cost to build?
- Who will I sell it to?
- How much can I sell it for?
- Where can I get the money?
- How much profit will I make?

These questions can best be answered with a detailed feasibility study of the marketing, economics and finance of a project. The issues and the policies that will help investors obtain positive findings will be the focus of the workshops that will follow these presentations.

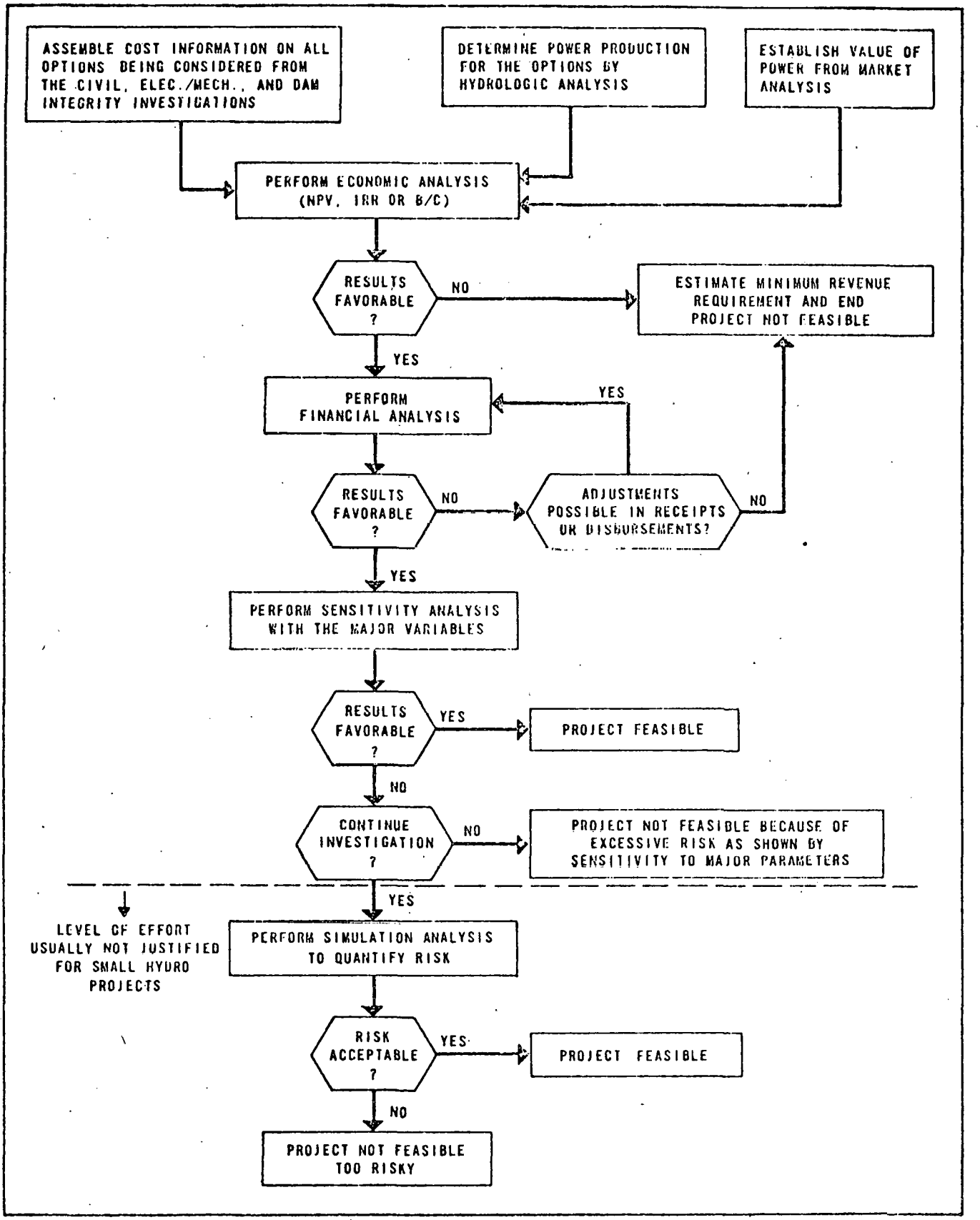

Figure 1. Summary Procedure for Determining the Economic and Financial Feasibility for Small Hydro.

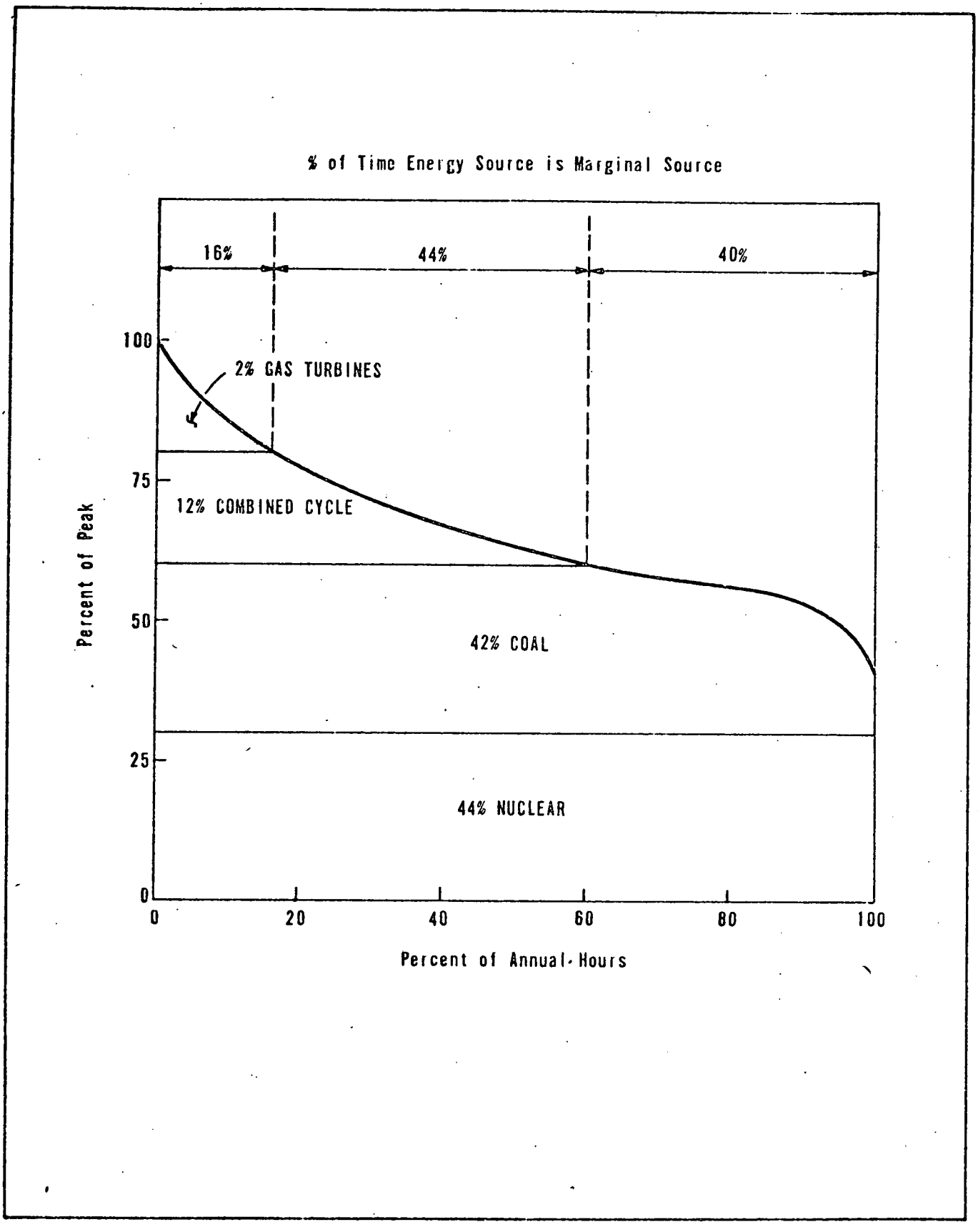

Figure 2. Hypothetical Example of Utility Power Value Calculation.

*** NET PRESENT VALUE CALCULATION ***

(0.0% PRICE ESCALATION , 10.0% INTEREST)

YEAR	CAPITAL COSTS	OTHER COSTS	BENEFITS	NET ANNUAL BENEFITS (4-2-3)	PRESENT VALUE FACTOR	PRESENT VALUE (5)*(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	$600,000			$ -600,000	1.000	$-600,000
1	900,000			- 900,000	0.909	- 818,181
2		45,000	245,000	200,000	0.826	165,289
3		45,000	245,000	200,000	0.751	150,262
4		45,000	245,000	200,000	0.683	136,602
5		45,000	245,000	200,000	0.620	124,184
6		45,000	245,000	200,000	0.564	112,894
7		45,000	245,000	200,000	0.513	102,631
8		45,000	245,000	200,000	0.466	93,301
9		45,000	245,000	200,000	0.424	84,819
10		45,000	245,000	200,000	0.385	77,108
11		45,000	245,000	200,000	0.350	70,098
12		45,000	245,000	200,000	0.318	63,726
13		45,000	245,000	200,000	0.289	57,932
14		45,000	245,000	200,000	0.263	52,666
				NET PRESENT VALUE OF PROJECT =		$- 126,662

(7.0% PRICE ESCALATION , 10.0% INTEREST)

YEAR	CAPITAL COSTS	OTHER COSTS	BENEFITS	NET ANNUAL BENEFITS (4-2-3)	PRESENT VALUE FACTOR	PRESENT VALUE (5)*(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	$600,000			$ -600,000	1.000	$-600,000
1	963,000			- 963,000	0.909	875,454
2		51,520	280,500	228,980	0.826	189,239
3		55,126	300,135	245,008	0.751	184,078
4		58,985	321,145	262,159	0.683	179,058
5		63,114	343,625	280,510	0.620	174,174
6		67,532	367,678	300,146	0.564	169,424
7		72,260	393,416	321,156	0.513	164,803
8		77,318	420,955	343,637	0.466	160,309
9		82,730	450,422	367,691	0.424	155,937
10		88,521	481,952	393,430	0.385	151,684
11		94,718	515,688	420,970	0.350	147,547
12		101,348	551,786	450,438	0.318	143,523
13		108,443	590,412	481,969	0.289	139,609
14		116,034	631,740	515,706	0.263	135,801
				NET PRESENT VALUE OF PROJECT =		$619,738

Table 1. Example Calculation of Net Present Value Without and With Price Escalation.

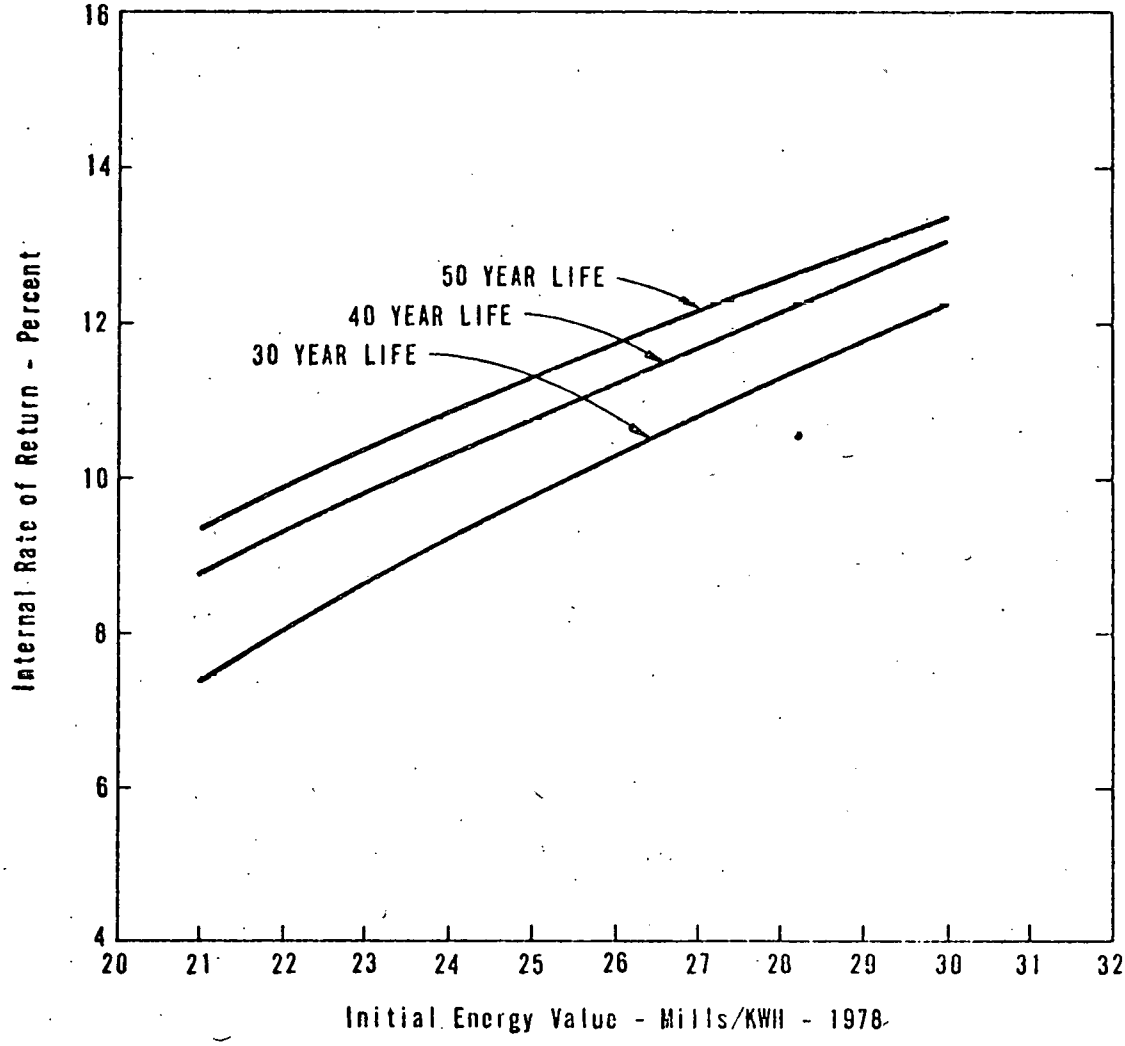

Figure 3. Example of Sensitivity Analysis.

HYDROPOWER AND THE BUREAU OF RECLAMATION

Nelson J. Jacobs
Bureau of Reclamation

THE PAST

The Bureau of Reclamation was established to carry out the provisions of the Reclamation Act of 1902. The purpose of that act was the "construction of irrigation works for the reclamation of arid lands" in the 17 westernmost of the contiguous 48 states. Providing water supplies to "reclaim" lands for irrigated agriculture was the primary initial mission of Reclamation and remains today as an important facet of Reclamation's concept of water resources development.

In the ensuing 75 years, Congress has enlarged Reclamation's mission to include multipurpose water resource development to meet the water needs of an ever-expanding population. Today, Reclamation developments help to meet the needs for water supply, improvement of water quality, flood control, river regulation, fish and wildlife enhancement, recreation, pollution abatement, and hydroelectric power.

Since the beginning of operation of the first 1200-kW unit on the Minidoka Project in Idaho in 1909, Reclamation has constructed and operated 50 hydroelectric powerplants in the West, with a total installed capacity of over 10,000 MW, making Reclamation one of the Nation's largest producers of hydroelectric power. Some of the best known of Reclamation's powerplants are at Hoover Dam and Glen Canyon Dam on the Colorado River and Grand Coulee Dam on the Columbia River, which has a present capacity of over 4100 MW.

In addition to these generating facilities, Reclamation has constructed over 16,000 miles of transmission lines to distribute the power and energy produced. The DOE (Department of Energy) recently assumed responsibility for transmission of federally produced power, and all Reclamation transmission facilities, except on-project facilities, were transferred to that agency.

THE PRESENT

In recent years, the problems of energy availability and increasing costs for energy development have led to a national effort to develop economical and

environmentally acceptable energy resources. Studies were undertaken to investigate the potential for adding capacity at some of Reclamation's operating powerplants. Grand Coulee Powerplant, for instance, is being expanded with a Third Powerplant which, when completed, will increase the total installed capacity to about 6200 MW. Additional studies are underway to extend the Third Powerplant and provide a total installed capacity of about 8600 MW. Studies are in progress to investigate possible additions at Hoover Dam. Although studies to date indicate that between 500 and 1000 MW additional capacity may be optimum, schemes with up to 2000 MW of additional capacity have been considered. Studies such as these showed that additional hydroelectric development at existing Reclamation facilities was possible.

Reclamation then undertook a study to evaluate, compare, and prioritize a number of potential hydroelectric developments in the Western United States. The study, completed in February 1977, was called the WEES (Western Energy Expansion Study). Eighty-five potential hydroelectric developments were evaluated and prioritized for further study. Although many of these had been investigated in the past, it was considered necessary to reevaluate them according to today's criteria of economics and environmental and social concerns. In addition, potential uprating of existing Reclamation powerplants was investigated and the potential of geothermal, solar, and wind energy was addressed. Table I shows a summary of the study proposals considered.

As a result of the evaluation, further site-specific study of 34 potential hydroelectric developments was recommended. Of these, 27 were of conventional hydroelectric development and 7 were of pumped-storage schemes. Table II shows the study schedule recommended as a result of the WEES. The majority of the proposed conventional hydroelectric developments involve adding capacity at existing Reclamation powerplants or additions of powerplants at existing Reclamation facilities.

Primarily as a result of WEES, Reclamation has presently in progress 31 planning studies of projects that include hydroelectric development. Table 3 lists those planning studies. Funding for these studies comprise about one-fourth of Reclamation's plan formulation budget. The total estimated capacity at these sites is over 13,600 MW; however, the majority of these studies are of relatively small additions to existing Reclamation facilities. The greater

part of this potential capacity is in five pumped-storage schemes and a few large hydro additions. Depending upon the length of the congressional authorization process, it is estimated that those projects which proved to be feasible and acceptable developments would come on-line in the 1985 to 1990 time-frame.

Historically, hydropower in the West has meant large, high-head plants. It is generally felt, however, that the majority of the large, high-head sites in the West have either been developed or are not practical for development due to today's environmental and social concerns. This was evident during the WEES evaluation. Those potential developments ranking high on the resulting prioritized list were additions to existing Reclamation facilities, which would result in minimal environmental or social impacts. Until recently, little effort has been made to determine the potential for low-head hydroelectric power in the West. Development of low head hydroelectric power is generally regarded as less environmentally objectionable than most alternatives and, therefore, should be more acceptable. The changing economics of thermal power development, due to escalating capital costs and fuel costs, are also making low-head hydropower an economically attractive alternative. As a result of deliberations and evaluations during the WEES, Reclamation is undertaking a Low-head Hydroelectric Evaluation and Inventory covering the 17 Western States. This study began this year and is projected to be a 3-year effort. For purposes of the study, low-head is defined as having a normal operating differential water surface of not more than 20 m (approximately 66 ft.).

The study effort is being closely coordinated with the Corps of Engineers' National Hydropower Study to preclude duplication of effort and insure compatibility of study methodology and results. The study will be performed in three phases, as shown in Figure 1.

Phase I. - The initial phase will be accomplished by a five-man multidisciplinary Reclamation team with the assistance of Reclamation's seven regional offices and the Engineering and Research Center. Phase I will concentrate on identification of potential additions of hydroelectric capacity at existing Reclamation facilities such as dams, diversion dams, and canal drops, which were not included in the WEES assessment. This preliminary work is an attempt to identify some developments that could readily make

an early contribution of power and energy. The team will collect and analyze the operational flow data for the potential plant, perform preliminary designs and cost estimates, and do economic and financial analyses to determine the economic feasibility of the developments. For those that show economic feasibility, some preliminary assessment of environmental impacts will be done. Those that show both economic feasibility and acceptability from an environmental standpoint will be recommended for further, more detailed planning studies. It is estimated that Phase I will be completed in 6 to 8 months.

Phase II. - Phase II of the study is the major inventory phase. Work in phase II, which is being carried out concurrently with Phase I, will begin with the Corps of Engineers' inventory data base being assembled as part of their National Hydropower Study. The total nationwide listing included in the data base will be screened to isolate all existing dams and identified potential sites in the 17 Western States. All existing dams with more than 20 m of head will be eliminated from the listing and potential sites with more than 20 m head will be reanalyzed as low-head developments. In addition, the listing will be augmented by identifying as many additional low-head sites as is practical, considering limitations of time and funding. The result will be an inventory of potential low-head hydroelectric development sites in the 17 Western States. It will consist of:

1. All existing low-head dams
2. All previously identified potential low-head damsites
3. All previously identified high-head damsites, reanalyzed as low-head developments
4. Newly identified potential low-head damsites

In addition to the extensive data base, the Corps has developed some very useful computer routines to analyze the data. The low-head sites identified during Phase II will be analyzed for power and energy potential and relative economic attractiveness using these computer routines, which consider a preliminary cost of the powerplant only. This analysis will be used as a basis for selecting approximately 100 sites as potential Federal low-head developments, which will be analyzed in more detail during Phase III of the study. It is estimated that Phase II will be completed in about 12 months.

Phase III. - The sites selected as a result of Phase II of the study will be analyzed and evaluated in more detail during Phase III. Available hydrologic data will be reanalyzed and a more exact estimate of the power and energy potential for each site will be made. Designs and cost estimates, approximately equal to Reclamation's appraisal study level, will be developed for each site. Wherease the Phase II analysis using the Corps' computer routines considered only powerplant cost, Phase III analyses will develop designs and cost estimate for the entire project, including powerplants, dams, dikes, spillways, outlet works, switchyards, transmission lines, and other features. Analyses will be performed to determine the economic and financial feasibility of each site and data with respect to environmental and social impacts will be gathered.

A final evaluation of these sites will be made using ranking and prioritizing methods similar to those used in the WEES. It is anticipated that a number of sites selected in the final evaluation will be inserted in Reclamation's planning program for more detailed planning and possible development. It is anticipated that Phase III will be completed in about 10 months.

Also as a result of the WEES, Reclamation has initiated a program to look at the potential for uprating all operating units at existing Reclamation powerplants. By replacing turbine runners and/or rewinding generators, it is possible, in some cases, to increase the capacity of a unit by up to 25 percent.

Reclamation is also actively studying the possibility of integrating wind and solar energy into Reclamation's operating hydropower system. One study actively in progress is investigating the potential integration of a large-scale wind development near Medicine Bow, Wyoming, into the Upper Colorado River hydrosystem. Another study, just recently begun, will investigate the potential integration of a large-scale solar thermal development in Southern Arizona into the Lower Colorado River hydrosystem. A third study to begin next fiscal year will investigate the potential of combined solar and wind development at Pacheco Pass in California to be integrated with the hydrofacilities of the Central Valley Project.

The resurgence of interest in hydropower, especially small hydropower develop-

ment, on a national scale is reflected in the present program of the DOE. Reclamation is cooperating with the DOE in several general studies of low-head hydrotechnology.

The first of these is an effort to generate cost data for small, low-head powerplants, which can be used in evaluation of low-head site during early stages of planning. This study is being done under contract by Tudor Engineering Company of San Francisco.

The second is a study of the marketability of power and energy produced by small, low-head hydroelectric plants. This is being done under contract by Systems Control, Inc., of Palo Alto, California.

Another study, being done in-house, is an effort to reduce costs of powerplants for low-head hydroelectric developments through standardization of designs for inlet and outlet water passage.

A fourth study, also being done in-house, will investigate the effects on power system operation from the development of a large number of small, low-head hydroelectric plants.

A fifth study is being done cooperatively with the National Marine Fisheries Service and Idaho Power Company. It is an investigation of fish mortality caused by passage through low-head turbines.

These five studies are in various stages of completion. All are scheduled to be completed by the end of FY 1980.

Reclamation recently entered into an interagency agreement to participate in President Carter's Rural Development Initiatives. Under this initiative, $300 million will be made available over the next 2 years for construction grants, loans, and loan guarantees for development of small-scale hydroelectric development. The program will be administered by REA, EDA, FHA, CSA, and HUD. Reclamation, the Corps, and the Federal Energy Regulatory Commission will cooperate with the DOE and assist in identifying and evaluating candidate sites.

Reclamation is contributing to other agencies' efforts in hydroelectric-related activities, such as providing input into evaluation boards for proposals under DOE's small hydroprogram and working cooperatively with the Corps in their National Hydropower Study.

THE FUTURE

It is evident that Reclamation's interest and involvement in hydroelectric power development has increased rapidly as the Nation's energy crisis intensifies. Any feasible hydroelectric development can make an important contribution toward supplying the Nation's power and energy needs. Small-scale hydroelectric development, although normally not capable of supplying on-peak power, can make important contributions of dependable baseload energy supplies. This will be of particular value in areas where significant oil supplies are used to supply baseload requirements.

Where firm seasonal power and energy can be produced, such as at irrigation canal drops here in the West, it will normally offset an equivalent seasonal peak demand for irrigation pumping. This type of generation would have a definite value for capacity and energy to a power system. It is anticipated that Reclamation's Low-head Hydroelectric Evaluation and Inventory will generate the same type of input in Reclamation's planning and development program as did the WEES. If so authorized by Congress, Reclamation will continue from this evaluation with more detailed site-specific studies and eventual development of those acceptable sites. In addition, the broader results of this evaluation will provide interested non-Federal developers with an identificationa and preliminary evaluation of a large number of potential low-head hdyroelectric development sites.

The DOE-sponsored studies will provide valuable information for use by potential low-head hydrodevelopers in estimating costs of potential developments and marketability of power produced from a potential development.

As in the past, Reclamation will continue to respond to requests from other agencies for participation in hydroelectric development activities insofar as is possible, considering limitations of manpower resources.

FEDERAL JURISDICTION IN THE DEVELOPMENT OF SMALL-SCALE HYDROPOWER

Ronald A. Corso
Federal Energy Regulatory Commission

I would like to express my appreciation for the opportunity to speak to you today regarding Federal jurisdiction as it relates to small-scale hydropower development. As you know, this is one of several conferences sponsored by the National Conference of State Legislatures and Franklin Pierce Law Center under the auspices of the Department of Energy. It has been my experience, in participating in these conferences, that they have been invaluable for disseminating information on small-scale hydropower and encouraging development. As a result of these conferences, the Federal Energy Regulatory Commission (FERC) has noted that new proposals for development are being initiated.

Often, when a representative of the FERC attends conferences of this type, we are asked questions about the agency and its purpose. For instance - What is an FERC? Why is there an FERC? What is it purpose? Is my project subject to licensing? Why me - I'm too small? What's a navigable river, a Taum Sauk decision, an Androscoggin decision? Many of the questions represent legitimate concerns, suspicions, apprehensions, and general disillusionment of the Federal bureaucracy. Other questions represent an unfamiliarity with the Federal Power Act and its role in non-Federal water resource development for almost 60 years. In this paper I will attempt to answer some of your questions, and, more important, hopefully convince you that it is the FERC's objective to assure that the burden of a Federal license is not time-consuming or costly.

Early in the infancy of water resources development, Congress realized that it could not continue to authorize each project through special legislation. Therefore, Congress divided its authority, retaining the direct authority over Federal Development, and delegating to the Commission through the Federal Water Power Act (Act) of 1920 the authority to license non-Federal hydroelectric developments. The Act was later substantially amended to its present form in 1935. Briefly, the Commission is authorized to license non-Federal developments that (1) occupy in whole, or in part, lands of the United States; (2) are located on

navigable waters of the United States; (3) utilize surplus water or water power from a government dam; and (4) affect the interests of interstate commerce. Court interpretations of the Commission's jurisdiction have defined this authority so that it covers virtually all projects. The most significant court interpretations were the Androscoggin River case which defined logging and other historic navigation and commerce as constituting navigation under this Act, and the Taum Sauk decision which defined the interconnection of project transmission lines with an interconnected/interstate transmission system as interstate commerce.

The Act has no minimum size limit for licensing. However, the Act does permit the FERC to waive many of its requirements for projects of 1,500 kW or less.

The purpose of Federal licensing is perhaps best stated in Section 10(a) of the Federal Power Act which requires the Commission to assure that - "the project adopted . . . will be a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, and for other beneficial public uses, including recreational purposes . . .". In more direct terms, Congress wanted to assure that hydropower development in any river basin would be compatible with the overall best use of the resource. In addition to the Federal Power Act, Congress has enacted a number of other statutes to assure the original intent of the Act and to protect special interests. These more recent statutes, enacted during the last decade, are principally environmentally-oriented. Although these environmental laws have been enacted for good reason, they are a mixed blessing for small-scale hydro power development. As with any generic legislation, small and large projects are treated equally. As we all know, the problems associated with small-scale development are not of the same magnitude as with large development, particularly new large projects. Later in this paper, I will discuss briefly the constraints placed on FERC by other statutes in administering its licensing authority.

The small-scale developer often questions the benefits of a license. In our opinion, there are several benefits associated with a Federal license. First, a Federal license assures an absolute right to develop a hydro site. Rights necessary to development may be obtained through the eminent domain authority conferred on licensees by Section 21 of the Federal Power Act. The Commission has a fully staffed and recognized dam safety program that includes annual inspec-

tions of all projects to assure the continued safety of all structures. The FERC provides prospective developers with a focal point to assist in complying with the innumerable other Federal and State requirements. For example, the FERC in its regulations, offers all applicants and licensees Staff assistance in the project area or in our Washington and Regional Offices. Finally, and perhaps most important, a Federal license and the provisions of the Public Utility Regulatory Policies Act (PURPA), when considered together are of considerable benefit when a developer is attempting to obtain financing, and provide assurance of a market for the project's power output at reasonable rates. The FERC authority under PURPA may be the single most important legislation to small-scale hydropower development in many years because of its far-reaching implications in relation to interconnections and wheeling for small power producers.

The most frequent question - "How long can I expect to wait before a license is issued?" - is without doubt the primary concern of developers, small and large. Despite what you have heard, the licensing process has improved considerably. In fact, the normal time now is one year or less for small-scale developments utilizing existing dams.

There are, however, a number of constraints that impact on the Commission's ability to eliminate delays. Some of these constraints are:

(1) Conflict between the statutory authority of the FERC and other Federal agencies, particularly the Corps of Engineers, Department of the Interior, and Department of Agriculture.
(2) Competing applications for the same site by public and private or Rural Electric Cooperatives. Competition for sites requires a legal and an engineering analysis. As you know, the legal process can be protracted resulting, in some cases, in hearings and litigation.
(3) Deficient applications. As discussed later, we have taken steps to simplify FERC regulations that should alleviate this problem.
(4) Lack of a market for project power output. We have experienced considerable delays while awaiting completion of negotiations and a signed contract for the sale of project power output. We believe PURPA will resolve most of the problems in this area.
(5) Finally, any developer always runs the risk that there may be a party

that is opposed to development or desires assurance that the project is constructed and operated in such a way as to not infringe on other interests. Intervention by a party, whether it be an agency, individual, or others, particularly on environmental grounds, could result in lengthy delays. In some instances, this has resulted in the demise of projects.

Item 1 above deserves special attention. At last count, there were 17 other statutes enacted by Congress with which the FERC and applicants must comply before a license is issued. As mentioned previously, these statutes often result in conflicting or overlapping authority being vested in other agencies. For example, Section 405 of PURPA, while authorizing establishment of simple and expeditious licensing procedures by the Commission, does not exempt any project from meeting the requirements of "the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Endangered Species Act, or any other provision of Federal law".

Many of these Federal laws require the Commission to consult with other Federal or state agencies prior to taking action on an application. Under the Fish and Wildlife Coordination Act, for example, the Commission must consult with the U.S. Fish and Wildlife Service and the state agency with expertise in fish and wildlife matters. Under the Historic Preservation Act, the Commission must consult the Advisory Council on Historic Preservation and the state historic preservation officer. PURPA itself requires the Commission to consult with the Council on Environmental Quality and the Environmental Protection Agency. Each agency has an independent conception of the binding nature of its input, and each agency's view points and expertise must and should be considered by the Commission.

There are many instances of concurrent or overlapping authority. Under the Federal Land Policy and Management Act of 1976, for instance, the Bureau of Land Management and the Department of Agriculture arguably have authority to deny projects on lands subject to their jurisdiction. Under the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), a prospective licensee must obtain a Section 401 water quality certificate from the Environmental Protection Agency or the state agency with authority to administer the Section 401 program before a license can be issued. Section 404 of FWPCA requires that a permit be ob-

tained from the Corps of Engineers if construction of the project will involve any placement of fill or other material in a stream. Finally, the Federal District Court for South Carolina held recently in South Carolina Wildlife Federation v. Alexander, Civ. No. 76-21657, that a hydroelectric dam may, under certain circumstances, be regarded as a "point source", thus requiring issuance of a National Pollutant Discharge Elimination System Permit by the Environmental Protection Agency under Section 402 of FWPCA.

The extent to which the Commission will be able to reduce the time required to process applications for small-scale projects at existing dams will depend in large measure on the willingness of these other agencies to take a cooperative and realistic attitude toward the assessment of the environmental impacts of such projects. To this end, we are endeavoring to expedite the process of coordination.

I should note that recent events have been somewhat discouraging because while the FERC has taken steps to simplify its regulations and licensing procedures, other Federal agencies have proposed new regulations that will undoubtedly result in further complexities. For example, your attention is directed to proposed regulations published in the Federal Register of May 18, 1979 by the U.S. Fish and Wildlife Service on the Fish and Wildlife Coordination Act and the Department of Agriculture, U.S. Forest Service, on the Federal Land Policy and Management Act. In both proposals, there is no recognition as to size of project or type, i.e. existing dams versus new projects or small versus large projects. Therefore, the small development, the development utilizing an existing dam, and a new project are subject to the same requirements. In my opinion, these regulations and others include unnecessary duplication of effort and overly burdensome requirements for the small developer.

One area that has recently been the subject of considerable discussion is the respective roles and authorities of Federal and State agencies. Although the Federal involvement with small-scale hydropower may seem complex, at least it is consistent nationwide. At the State level, there are arguably 50 different sets of rules. This creates confusion since most developers must retain an engineering firm to prepare the design and assist in obtaining the various authorizations. There are a number of qualified engineering firms. However, unless some uniformity and effort to simplify requirements and eliminate unnecessary

duplication is initiated, there will be delays and the inherent escalation of costs attendant with delays, even with an experienced consulting firm.

In its effort to simplify regulations, the Commission has attempted to recognize the role of the States and other Federal agencies. Therefore, we have established a consulting/liaison concept, partly through the requirements of other statutes and partly because of our policy to assure the least conflict between the interests of the Federal and State agencies and the developer. Under the FERC regulations, developers are required to consult with other Federal and State agencies during license application preparation to surface potential problems and incorporate solutions to those problems in the proposal. Ideally, when an application is submitted to FERC, a minimum amount of effort is necessary for our review and analysis. We believe this will significantly reduce license processing time and benefit all concerned parties.

State agencies interested in developing simplified procedures are encouraged to examine our new regulations, and review the efforts of other States that have initiated changes to that end. In this regard, it is suggested that you review the efforts of the state of Massachusetts to simplify its requirements. I would also recommend that you review the State of New Hampshire Public Service Commission's ruling on rates for sales of power from small-scale hydropower developments. The latter is the first instance where a State public service commission has issued an order on rates pursuant to PURPA. The ruling is extremely important and necessary to the financial viability of a small-scale development.

I would now like to describe some of the changes by FERC that we believe will significantly reduce the licensing and permitting problems, and hopefully, provide a solution to certain regulatory issues within the purview of FERC. These changes can be divided into five major areas: (1) short-form license (minor), (2) procedural changes for processing preliminary permits, (3) changes to general filing requirements and criteria for evaluating applications for permits and licenses, and simplified preliminary permit application requirements, (4) simplified regulations for major projects-existing dams, and (5) regulations for conduit hydro facilities. The important consideration in the changes implemented by the FERC was to eliminate the legalese from its regulations and to develop understandable regulations so that it would not be necessary to retain expensive legal and engineering assistance to provide interpretation for the small developer

The initial step by FERC was last year. Partly in response to the increasing numbers of applications and in anticipation of the enactment of the National Energy Act, the Commission initiated a revision of its licensing requirements and procedures in their entirety. The first phase (Phase I) was instituted in September 1978 with issuance of the "Short-Form" License procedures for all projects with an installed capacity of 1.5 megawatts or less--the so-called "minor" projects. Most of you are familiar by now with the Short-Form license. Therefore, I will not describe the Short-Form in detail.

The second change took place on January 2, 1979, when the Chairman notified all major Federal agencies by letter that preliminary permit applications would be processed by a simpler and less time-consuming process. Basically, the new procedure discontinued the practice of sending numerous copies of applications to agencies for comments. Comments are now solicited through the FERC public notice procedures only. The public notice issued by FERC has been expanded to include all the information, including a map, necessary for commenting agencies to provide intelligent comments. This procedure has reduced processing time to one-half or less.

On March 5, 1979, the Commission issued a notice of proposed rulemaking (Docket No. 79-23) that prescribes general filing requirements and evaluation procedures applicable to both preliminary permit and license applications, and simplifies the regulations relating specifically to applications for preliminary permits, amendments to permits, and cancellation of permits.

The primary goal of the preliminary permit revisions are to eliminate all filing requirements that are not related centrally to the purpose of a permit. The existing preliminary permit regulations require, for example, extensive documentation of the nature of the applicant and the extent of his authority to operate power facilities in a State. An applicant must therefore provide multiple copies of corporate charters, bylaws, stockholders' resolutions, state laws, etc. The revised regulations would eliminate these requirements as superfluous.

The revised regulations would reduce the required filings from nine to four substantive exhibits. The first exhibit would constitute a description of the proposed project, to be provided in whatever specificity the applicant is pre-

pared to give. The second exhibit would include a study plan and work schedule for the investigations and other activities to be carried out under the Permit. Since the protection afforded by a permit is meaningless unless the permittee files its application for a license during the term of the permit, this exhibit would require the applicant to specify the interval during the permit when a final determination as to the feasibility of the project will be made, and the interval when an application for a license will be filed, if appropriate. This exhibit would help the Commission assess the applicant's ability to accomplish its plans in the time provided, and would enable the Commission to monitor the progress of the permittee during the permit.

The third exhibit would include a statement of costs and financing. This exhibit would simply inform the Commission as to the financial ability of the applicant to carry out the necessary activities under the permit. Any tentative information that is available concerning the ultimate market for project power would also be provided.

The fourth and final exhibit would be a map or maps showing the geographical location of the project, the physical interrelationships of its principal features, and a proposed project boundary.

The new regulations also address the treatment of competing applications. Such applications would have to be filed within a certain period of time following public notice of the initial application. The prescription of a deadline for competing applications would inject a greater element of certainty into preliminary permit and license proceedings, and would help us avoid the indefinite delays that may occur under current circumstances.

The fourth change (Phase II) in regulations, also applicable to small hydro, was issued by a notice of proposed rulemaking on April 19, 1979 (Docket No. 79-36). The regulations pertain to applications for licenses for "major" projects (capacity greater than 1.5 MW) which utilize, or would utilize, the water power potential of existing dams only. The regulations therefore govern applications which seek: (1) an initial license for an existing hydroelectric project with total installed and proposed capacity greater than 1.5 MW; (2) a new license for an existing hydroelectric project with total installed and proposed capacity greater than 1.5 MW; or (3) an initial license for a proposed hydroelectric project at

an existing dam or dams, with proposed capacity greater than 1.5 MW. The projects in these categories are referred to generically as "major projects - existing dams". Note that there is no capacity limitation. The only limitation is that there must be an existing dam or other facility. The revisions made in the Phase II regulations provide a measure of the degree of simplification. We have in these regulations reduced the number of required exhibits from 23 to 7, and the number of words in the regulations from 10,700 to 2,300 (an 80% reduction).

The Phase II application requirements include an initial statement and seven exhibits. The initial statement provides certain basic information, including the nature of the application, the names and business addresses of the applicant and its authorized agents, the nature of the applicant, and the name and location of the project. The applicant is also required to state that it has complied with the laws of the state where the project is located with respect to obtaining property rights and the rights to appropriate, divert, and use water for power purposes, and with respect to obtaining authorization to engage in the business of producing, transmitting, and distributing power and any other business necessary to accomplish the purposes of the requested license.

Exhibit A provides a description of the physical structures and features of the project. If the project includes more than one dam and associated facilities, each such discrete development must be described separately. The exhibit also includes a tabulation of any lands of the United States that are enclosed within the project boundary. This tabulation is necessary in order to record accurately the lands which have been reserved from entry, location, or other disposal pursuant to Section 24 of the Federal Power Act (Act).

Exhibit B provides a statement of project operation and resource utilization. The exhibit calls for a description of the available resource (flow and head) and a technical description of the proposed use of the water resource for the generation of power. The applicant must also explain how it intends to dispose of the power. Finally, the applicant must describe any plans for future hydroelectric development on the affected stream. The information in this exhibit will assist the Commission in determining whether the applicant's existing or proposed development and operation are the optimum development of the waterway, as required by Section 10(a) of the Act.

Exhibit C provides a construction history and a proposed construction schedule for the project. The construction history, which need only be filed if the applicant is seeking an initial license, calls for a tabulated chronology of construction for the existing project structures and facilities, including the dates of commencement and completion of construction or installation, and the dates of commencement of commercial operation. This information is requested for several reasons. First, if the project is located on a non-navigable waterway, and the sole possible basis for the Commission's jurisdiction is the fact that the project affects the interests of interstate or foreigh commerce, jurisdiction does not attach unless there has been "construction" at the project. Second, if the project is a constructed hydroelectric project located on a navigable waterway, Commission policy may call for backdating for the effective date of the license or retroactive assessment of annual charges to the date of unauthorized construction. Finally, substantial reconstruction may terminate a Congressional authorization for the project which antedated the Federal Water Power Act of 1920. An applicant seeking a license for a proposed project at an existing dam would only be expected to give approximate dates for the dam and any other existing structures.

The construction schedule is required only if new development at the project is proposed. The schedule would aid in a precise understanding of what is being proposed, and would facilitate establishment of a construction timetable in the license, if issued, as required by Section 13 of the Act.

Exhibit D provides a statement of costs and financing. If the applicant seeks a new license for a constructed project, and is not a municipality or a state, it must provide an estimate of the amount that would be payable if the United States exercised its right to take over the project upon expiration of the initial license pursuant to Section 14 of the Act.

If the applicant seeks an initial license, information concerning the original cost of land or water rights and existing project works must be provided. The Commission is required by Section 4(b) of the Act to obtain information on the original cost of a project.

Estimated costs of any proposed new development and estimated annual costs must also be provided, as well as information concerning the value of project

power to the applicant and the sources and extent of financing and annual revenues available to meet the estimated costs. This information would enable the Commission to assess the economic and financial viability of the project.

Exhibit E provides a report on the environmental resources of the project, the impacts of the project on those resources, and the proposed measures to mitigate the impacts or to protect and enhance the resources. The information required in this exhibit is, in many respects, less detailed and extensive than the information required by the existing regulations governing applications for all major projects. The less stringent requirements are justified on the basis that the major impacts associated with construction of the dams and creation of the impoundments have already occurred. The exhibit must include reports on water use and quality; fish, wildlife, and botanical resources; historical and archeological resources; recreation resources; and land management and aesthetics. Sufficient information is required in this multifaceted exhibit to ensure that further impacts will be identified and taken into account pursuant to the National Environmental Policy Act of 1969.

The exhibit requires applicants to consult with other local, state, and federal agencies with expertise in environmental matters prior to filing their applications. Under our existing regulations and procedures, other agencies frequently are not even aware that development is being proposed until after the application has been filed with the Commission. Proceedings must often be delayed while agencies consider the effects of projects on their areas of responsibility and provide recommendations. With pre-application consultation, problem issues will be identified and addressed at an earlier point in the process, and the Commission's own required consultation with other agencies will be expedited. Moreover, in certain circumstances, other agencies may have concurrent jurisdiction with respect to authorization of a project. Prior consultation by applicants will facilitate coordination with these other agencies.

Exhibit F consists of general design drawings of the principal project works. The drawings must show a plan, elevation, and profiles and sections for each structure, and must be accompanied by sufficient information concerning structural strength and stability and other controlling factors to demonstrate that the structures are safe and adequate for their stated functions.

Detailed working drawings showing the precise plans and specifications for proposed project structures are not to be filed with the application, but should be prepared for the purposes of construction and retained after construction is completed as permanent project records.

The final exhibit, Exhibit G, is a map of the project, The map must show the geographical location of the project, the physical interrelationships of project works and other features, a project boundary enclosing the project works and all lands and waters necessary for project purposes, and any lands of the United States that are within the project boundary.

In preparing the Phase II regulations, we have attempted in several ways to ease the burden of compliance. First, we have tried to reduce the requested information to the bare minimum that is needed for the Commission to carry out its responsibilities. Second we have attempted to consolidate requests for information according to related subject matter. All paragraphs and exhibits requesting information on environmental matters, for instance, have been consolidated into the environmental exhibit. The organization of the requirements reduce confusion and redundancy in the materials submitted.

Finally, we have endeavored to minimize the element of subjective interpretation in our requirements by reducing the requests for information, where possible, to simple, objective descriptions of what is desired. The FERC staff is available to assist in overcoming any unavoidable problems of interpretation. We hope that these simpler requirements and your cooperation will help us avoid the application deficiencies that have plagued our licensing program in the past, and thereby expedite the licensing process.

There is one final change in the regulations that should be noted. Section 213 of the Public Utility Regulatory Policies Act (PURPA) amended the Federal Power Act to grant the FERC discretionary authority to exempt in whole, or in part, conduit hydro facilities from licensing requirements. On April 20, 1979, the Commission issued a proposed rulemaking (Docket No. RM 79-35) setting forth the requirements for applications for exemption. Basically, these regulations are the same as the short-form, except they will be applicable to projects up to 15 MW, and will require less information than the short-form. Under these regulations, all conduit hydro facilities will be exempted within 90 days of receipt of an accept-

able application. Projects subject to exemption are all projects on a conduit, canal, pipeline, etc. used primarily for domestic, agricultural or industrial purposes that discharge flows used for hydropower into a conduit.

When the regulations become final in a few weeks, the FERC responsibilities under the Public Utility Regulatory Policies Act will have been fulfilled. We hope that you will agree that the changes made by FERC are far-reaching, and that we are dedicated to encouraging small-scale hydro development by implementing a less burdensome licensing process.

A LOOK AT SMALL-SCALE HYDRO IN CALIFORNIA

Assemblyman Meldon Levine
California Assembly Subcommittee on Energy

I'm told there are 220 persons enrolled for this conference. It is heartening to see that so many of you have taken the time for travel to a session on the relatively esoteric topic of small-scale hydro. From my experience as Chairman of the California Assembly Subcommittee on Energy, I've come to realize how crucial it is for key state legislators to be knowledgeable and persistent in seeking out the best and least impactive combination of future energy supply options. It is for this reason that I am honored to be able to speak to you today as an advocate of small-scale hydro.

California's relatively unique combination of coastal-sierra geography and climate makes hydroelectric energy a major building block of our electricity supply system. We currently have 8,700 MW in operation, which is almost 20% of total California electricity supply. This includes 350 MW, at 49 sites, of installations with less than 15 MW capacity.

Though many advocates of conventional, central station power generation would have us believe that our hydro potential has been fully realized, such is actually not the case. Several thousand MW of additional hydro potential has been identified in California, including more than 500 MW potential of small-scale development with 1500 MW's, a relatively conservative estimate of the total California small-scale resource.

CALIFORNIA'S INTEREST IN SMALL-SCALE HYDRO

Along with the many states represented here today and others around the country, California's interest in small-scale hydro stems from the fact that it is basically a benign "alternative" technology. Not only is it benign, but it is a technology which is available right now -- a combination which is relatively rare.

The environmental virtues of development at existing sites -- no air pollution, no water consumption, no radiation, no land disruptions, are clear. Besides what may become available in the future when technology improves and is standardized, we have on hand tried and true systems. Many facilities in California, some of

which are 75 years old, can be kept in operation for many more years with simple maintenance.

Within this general context, let me review with you some of the more specific facets of the California energy picture which make small-scale hydro particularly attractive to us.

OIL DISPLACEMENT

California's existing electricity generation capacity is predominately oil based. Oil-fired capacity constitutes 59% of our MW capacity, generating more than half of the kilowatt hours consumed. This relatively large, and for the near term permanent commitment to oil is of course: (1) expensive to run; (2) subject to supply disruptions; and (3) very hard on our air quality. These negative impacts from our existing generation system can be marginally diminished if, whenever possible, a more benign fuel supply or generation source can be substituted for the oil-fired generation. For our system, small hydro is one of the more desirable options, as it would generally substitute directly for oil.

ECONOMIC VIABILITY

Thus, in California with the cost of oil as one of the most critical factors in a comparison of supply options, there is little question that small hydro is a sound investment, even without crediting its environmental benefits.

While economic considerations are highly site and utility specific, many of our recent feasibility studies have come in at the 20-30 mills per kwhr range. With today's $20/barrel oil, the fuel-only cost for oil-fired plants is around 32 mills/kwhr.

These figures assume no capacity credit for the hydro, which is highly conservative in California since much of our potential is in irrigation canals with flows which could coincide with the summer demand peaks. Scheduling would thus allow at least some firm capacity credit such that in addition to simple fuel substitution, small-scale hydro would be able to replace some (albeit little) new capacity expansion.

With the incredible oil price escalations we've been experiencing and face in the near future, hydro economics can only solidify. The plants built now will

be generating power well into the 21st century, using a virtually free, escalation-proof fuel. Regardless of this, major private utilities consistently under this resource, offering only 14-22 mills per kwhr.

Because of the relatively short lead time for small-scale hydro projects (the actual construction period for some small plants can be one year or less), with a concerted licensing effort, they could play a strategic role in California's near-term electricity supply planning.

This is very difficult to analyze, as the need-for-power issues are extremely complex, and matching an uncertain electricity demand with the optimal supply package is a very complicated problem not amenable to simply solution.

Within all these caveats however, there is the potential that small-scale hydro could bridge some of the mid-eighties energy (kwhr) gaps which were assessed in our 1978 debate over the Sundesert Nuclear Plant. While the small projects cannot substitute for needed new baseload capacity, they could provide some breathing space as we continue to plan and construct the major baseload plants.

UTILITY INTEREST

Increasing utility interest is evidence of the favorable economic and timing considerations, and is a final reason why small-scale hydro is a particularly significant "alternative" option for California.

- The Sacramento Municipal Utility District is actively considering 5 projects (22 MW) ranging in size from .4 to 10 MW, which could be completed in 1981.
- The Los Angeles Department of Water and Power is adding 6400 KW and 48 million kwhr per year at an existing plant. It has also completed feasibility studies on 3 projects (6.3 MW), 4 sites are currently under study (1.9 MW) and reviews are planned for 16 water system pressure regulating facilities with combined potential of 4.1 MW.
- The Metropolitan Water District of Southern California is currently constructing 30 MW of small projects on its aqueducts. These projects will be on line in 1980. An additional 35-40 MW is in planning for installation by 1983.

REALIZING CALIFORNIA'S SMALL-SCALE HYDRO POTENTIAL

To reiterate, California's unique combination of coastline, mountains, irrigated

agriculture, smog and oil-fired power plants make the prospects for extensive small-scale hydro development quite positive.

In concert with our also unique political climate, nationally reknowned for advocation of innovative, decentral technologies and lifestyles, development should be proceeding full speed ahead. Predictably of course it isn't, as I suspect that we have found the same obstacle you have.

I'd like to mention the major obstacles we've seen and highlight ongoing or proposed state efforts to hasten development. I will be most brief in my discussion of the obstacles as they are not unique to California and have been discussed extensively elsewhere and already here today.

ASSURING MARKETABILITY OF ELECTRICITY

The initial problem arises in assuring the existence of an economic market for small-scale hydro electricity. (This is necessary both for even an initial assessment of feasibility, as well as for FERC licensing), with the two predominant issues being the price paid for the electricity and the ability to develop a competitive market through "wheeling" it to users.

The price paid the hydroelectric developer should reflect the incremental cost of the generation it replaces, which as I mentioned earlier in California, is generally oil at roughly 32 mills per kwhr. (Again, assuming no firm value for the small-scale hydro.) In California we have found the major utilities highly reluctant to develop large quantities of small-scale hydro electricity or to pay oil-based prices to purchase it from non-utility developers.

The ability to develop price competition and encourage delivery of the electricity to the most lucrative market is perhaps a more serious problem. The wheeling issue is extremely complex and not amenable to treatment here, but existing wheeling legislation and precedents in California and the U.S. as a whole we have found are major barriers to extensive small-scale hydro development. We do have a statutory provision allowing private energy producers to wheel power from their point of generation to their own point of use. But as it currently stands, hydro is expressly defined not to be an alternative energy resource, and no provision is made for wheeling to one utility across another utility's lines.

CONFIRMING FEASIBILITY OF SPECIFIC SITES

One particular facet of the site feasibility problem in California I'd like to mention is that most of our potential projects are with public water supply, irrigation and flood control districts with governing boards not at all familiar with electricity generation, supply planning or utility practices. Moreover in this post Prop-13 era, they have very little money to spend on projects which present unknown risks. From all indications, they seem extremely interested, and it is therefore the financing of the site feasibility study that is more of a problem than the actual technical assessment.

FINANCING

Four particularly significant financing issues have become clear as California has been pursuing potential projects. Each of these could appropriately be the topic of an entire conference, so I will only highlight them.

The first is simply getting the feasibility studies initiated. As I indicated earlier, the water districts can rarely fund studies up front so mechanisms such as 90/10 grant/loan programs, (with paperwork application requirements substantially reduced), are necessary to help the development get underway.

A second financing issue is the so-called dry-year default problem. Municipal districts and investment firms are concerned that even though a project may generate substantial revenues in average and wet years, if a dry year occurred early in the project life, principal and interest payments might not be met from limited sales.

A third issue, is to fashion an adequately supportive role for the large utilities with respect to the independent water district developers. The central finance questions here include: (1) whether the utilities are required to purchase the small-scale hydro electricity; (2) what the utilities must pay if the water district finances and owns a project; and (3) whether utilities can be required to finance and own the small water district developments, paying some royalty to the district for the use of the water, should the district find this type of arrangement preferable to its ownership of the project.

A final financing issue is the relatively recent IRS ruling that nearly all long-term contract power sold to a private utility or federal marketing agency

must be financed under taxable bonds. As many are aware this ruling compromises the economics by effectively raising the interest rates from the 6-7% range to a much less desirable 9-10%, if the power is sold to private utilities.

So water districts are placed in a bind. If they sell to private utilities, they currently face lower prices and taxable financing; on the other hand, their access to municipal utilities is blocked by the lack of adequate wheeling.

LICENSING

Rather than dwelling on the federal licensing issues Mr. Corso has covered, I will instead review some of the state licensing concerns we have seen arise lately. I would, in advance though, commend the FERC efforts to develop short-form application processes for small projects, which promise to simplify and greatly lower the cost. I am concerned though that the process remains non-time-constrained, so the states will have to watch implementation and lobby for FERC funding to decrease case backlogs.

In California we instituted a time-constrained permit process for many projects last year. The primary permit for a small-scale hydro project is an application to divert water from Water Rights Division of the State Water Resources Control Board. Though the time limit is theoretically one year, two concerns have been raised. First, if the case is protested, all timelines are off. Thus the traditional protracted water rights protest process lasting two-to-three years can be followed even though in a small-scale hydro project no water is being consumed and the project does not alter the down-stream flow patterns. A second major concern is that anytime a water district petitions to change its existing permit (e.g., to begin generating), the water board has the theoretical right to revise its entire allocation scheme in that river basin.

OVERCOMING OBSTACLES

To be honest with you, the activities we have underway at the current time are not nearly as impressive as the list of obstacles I just set out! However, we have initiated the early stages of what I think promises to be a concerted push to eventually utilize much of our small-scale hydro resource. Let me mention a few current state activities:

- The State Energy Commission has a feasibility study grant program of about

$46,000 at six sites ($5,000-$15,000 each). An additional $100,000 is budgeted for 10 studies for 79-80, by the Energy Commission, and our Department of Water Resources has $100,00 budgeted for feasibility studies of potential projects to power the state water project.

- In conjunction with these feasibility studies, workshops are scheduled for water districts interested in small-scale hydro. The participants will include technical staff, engineering consultants, federal authorities and eater district officials who have successfully pursued small-scale hydro projects.
- To better utilize the comprehensive feasibility assessment manual recently prepared by the Corps of Engineers, our State Energy Commission will soon train its staff to make on-site preliminary feasibility assessments.
- The Commission staff has developed a model to support arguments for cost-based resale rates before the State Public Utilities Commission and FERC. The State Public Utilities Commission is expected to make some determination on rates and prices for co-generated and small hydro power this fall. This will set some precedents to guide future development.
- As well as these in-state activities, we are monitoring and participating in relevant FERC regulations and proceedings.

Actually, I'm more excited about the things I see on the relatively-near horizon. Some examples include:

- A proposal to allocate $5 million in state funds over 5 years for 90/10 type feasibility study loans to be repaid only if projects prove feasible;
- $7 million in state funding to guarantee bonds in the event of early dry-year defaults;
- State PUC orders to private utilities regarding improved marketing arrangements (purchasers, prices, and possibly wheeling) for small hydro;
- Improved coordination of advance utility supply planning and utilization of small-scale hydro resources;
- A review of the operations and development of the State Water Project to optimize power generation and minimize coincident utility peak demands.

I believe the most crucial areas for legislative initiatives will be in: (1) easing our restrictive wheeling laws; (2) creating the loan guarantee fund to assure revenue bonds against default in the first years of project operation; and (3) de-

signing a State Water Resources Control Board permit process tailored to small-scale hydro licensing concerns. As Chairman of the Assembly Energy Subcommittee, I and my colleagues will be exploring these areas further in hearings late this year.

BRIEFING ON SMALL HYDROPOWER DEVELOPMENT AT THE SOUTH COLUMBIA BASIN IRRIGATION DISTRICT

Larry Schwartz
Program in Social Management of Technology
University of Washington

ORIGIN OF IRRIGATION/HYDROPOWER FROM GRAND COULEE

- Prior to Great Depression - Central Washington State was essentially a vast desert with a big river

- NRA Irrigation Project - Reclamation of land, redemption of urban poor, veterans of WWI through irrigation of land for small family farms

- Columbia Basin Irrigation District organized in 1939 under Title 87 of Revised Code of Washington
  -provide financing for construction of water supply systems
  -act as mortgaging agency for those seeking Bureau of Reclamation water
  -view Grand Coulee and other hydropower as secondary function of water from the Columbia River

- Grand Coulee Dam
  -completed 1941, creating FDR Lake and sending about 80 million acre-feet/year of water through generators into normal course of Columbia River (electricity cost: 1/2 mill/kwh)
  -2 million acre-feet/year pumped up 287 feet higher to create Banks Lake in the Grand Coulee to the south behind Dry Falls Dam
  -600 million kwh/yr from Grand Coulee Dam used to pump this water into the 27 mile long Banks Lake equalization reservoir for the Columbia Basin Irrigation District. Storage volume 696,000 acre-feet.

- Columbia Basin Irrigation District today
  -3 Divisions: South, East, Quincy
  -333 miles of main canals
  -1936 miles of lateral canals
  -2223 miles of drains and waterways
  -½ million irrigation acres of land in 1977; 550,000 acres yet to be served

- 1939-1962 operated solely as Collecting Agency for U.S. Bureau of Reclamation while all other irrigation districts in the U.S. were user owned and operated

- 1962-1969 negotiations between District and U.S. for contract on water and for operation and maintenance of facilities; some friction between districts as to future directions.

- 1968 contract with Bureau of Reclamation has provision for the development of the hydropower sites, with prior approval of the Secretary of Interior required

- South Columbia Basin Irrigation District (SCBID)
  -5 Directors, all elected by farmers - set policy for the District
  -Secretary-Manager oversees all operations from Pasco, WA (Russell Smith)

SCBID SMALL HYDROPOWER SITES

- Six sites in the irrigation project are planned for development: 3 in South, 2 are shared by all three, one shared by South and East
  -power marketed as a package - about 100 mw total -- available from 15 March until 31 October
  -one site will take lead in attempt to ease the way for the others, -- P.E.C. 22.7
  -to provide base-load electricity in seven summer months. Although NW utilities are winter peaking, BPA can assist in marketing

KEY ACTORS

- Russell Smith, Secretary-manager, South Columbia Basin Irrigation District, Pasco, WA

- Harry Hosey, Tudor Engineering Co., Seattle, WA

- Gerry Garman, Director of Power Management, Seattle City Light, Seattle, WA

- Don Caha, Power Supply Supervisor, Tacoma City Light, Tacoma, WA

DEVELOPMENT OF CURRENT PARTNERSHIP

- 1962 Bureau of Reclamation Feasibility Study

- 1968 - Transfer of certain authorities to SCBID, including rights for future hydro development

- 1975 - Tudor Engineering begins to study small hydro potential with own funds; identifies possibility of SCBID

- 1977 - After periodic encouragement from Tudor, Smith agreed time was right for SCBID action; received OK from his Directors

- Late summer, 1977 - Smith receives OK from Reserve Board Committee (with reps of all three Districts) which was pessimistic about ability to get approval of Secretary on workable financing

- August, 1977 - letter requesting permission for development sent to Secretary of Interior; OK received April, 1979

- Spring, 1978 - Began identifying prospective purchasers/financing for developments; 26 consulted for partnerships using preliminary FERC applications
  -REA's and PUD's required BPA storage, so were dropped
  -Others eliminated themselves due to special requirements
  -Seattle and Tacoma bid cooperatively and were selected for further negotiations; Grant County PUD is standby

STATE AND LOCAL SUPPORT FOR SMALL HYDROPOWER

- State Legislature - Senate Bill 3172 adopted on March 12, 1976
  "The development and use of a diverse array of energy resources with emphasis on renewable energy resources shall be encouraged."

- Seattle City Council - Resolution 25260 adopted July 12, 1976
  "Hydropower shall be the preferred method of generating electricity so long as hydro resources remain that can be economically developed on an acceptable environmental basis . . . "

POWER PURCHASE AGGREMENT

- De Facto, as opposed to signed agreement reached on December 22, 1978

- SCBID will construct, own and operate the project. Financing the project through revenue bonds

- Seattle and Tacoma will purchase power output of project for a period of 40 years, beginning date of commercial operation, also:
  -obtain permit and licenses for power transmission
  -payments will be sufficient to cover
    Debt service on bonds
    O + M costs
    Funds required prior to bond sales

- After average costs for utilities reach the costs of production, benefits to be shared equally

POWER COSTS

- 1978 ESTIMATES - for electrical energy at Line Side Terminals of switch-yard transformer
  -13 mills/kwh (approx.) if financed with tax-exempt bonds
  -16 mills/kwh (approx.) if financed with non-tax-exempt bonds

- Tax-exempt bond issues totalling at least 3.65 million may take place, since agreement has been negotiated with publicly-owned electric utilities

- Seattle and Tacoma will pay at cost plus fixed-fee. About 15 mills/kwh

RETURN ON INVESTMENT -- DRY FALLS DAM

- SCBID receives at least 1.65/kwh over its costs for energy from project under agreement with Seattle and Tacoma. When average cost of energy to utilities from all power resources exceeds that of the project, the purchase price will be set so as to divide the difference equally between purchaser and seller

- Annual project generation over 40-year period 55-56.9 million kwh

- This would produce $92,000 annually in net revenues to the District, the equivalent of 0.67 percent of the total capital investment of $13,730,000. The rate of return to the District is expected to increase over time.

TAXES AND INSURANCE

- District is a non-profit organization and power will likely be sold to a public utility. Therefore, both the energy generated and the bonds will be tax-free

- The Equipment and Plant at Site 22.7 will be insured much the same as any other hydroelectric facility -- at .2% of the total construction costs. No insurance to be taken our for loss of energy production

REGULATORY CONSTRAINTS AND COSTS

"Our largest regulatory problem has been, and is expected to be, with FERC... The State process has been relatively easy, and State organizations have been cooperative..."

- Russell Smith, SCBID
  in interview, 21 May, 1979.

"Most of South's (SCBID) regulatory difficulties and expenses are created by the Federal, rather than State government".

- Harry Hosey, Tudor Engineering
  in interview, 22 May 1979.

COST OF STATE PERMITS

- Water Right Certificate (Permit to appropriate water)
  $10 plus, for each second-foot appropriated

1 - 500	$2 / sec-ft
500 - 2,000	50¢ / sec-ft
2,000+	20¢ / sec-ft

- Permit Filing & Recording

0 - 1,000	Horsepower	20¢ / HP
1,000 +	Horsepower	4¢ / HP

- Certifying copies recorded at DOE $2

- Blueprints required by DOE AT COST

- Each extension of time for beginning construction
  -½ filing & recording fee
  -other extensions $2

- Inspection by state AT COST

- Examinations of plans and specifications for safety
  -minimum $10 or At Cost

- Recording an assignment - permit to appropriate water $4

- A stream patrolman may be required where water rights are adjudicated
  -salary - borne by water users
  -metering equipment may be required by State

- Annual license renewal (future)

50 - 1,000 HP	10¢ / HP
1,000 - 10,000 HP	2¢ / HP
10,000 + HP	1¢ / HP

ENVIRONMENTAL IMPACTS

- Negative Declaration obtained for Site 22.7 from State Department of Ecology, despite proximity of State bird sanctuary

- Federal EIS not required

- Negative Declaration sought for all six sites, trouble expected with Summer Falls site

OBSERVATIONS AND CONCLUSIONS

- Individuals (entrepreneurial engineering company; activist secretary-manager) key to development of site

- Partly an Irrigation District strategy for growth. It hopes to grow in order to serve the additional ½ million acres allowed by contract with the Bureau of Reclamation

- Innovative Financing Scheme makes the project attractive to both SCBID and the purchasing utilities

- Use of one lead site a useful strategy to identify and prepare for legal and institutional obstacles -- State and Federal level

- Support from State, Press; no comments to date from environmental groups, neighboring towns and counties

- Widespread use of small hydro by irrigation districts may become a variable in current U.S. reappraisal of water rights and project policies

SUPPORT SERVICES FOR SMALL HYDROELECTRIC DEVELOPMENT IN NORTH CAROLINA

John L. Warren
Research Triangle Institute

SERVICES PROVIDED TO SMALL HYDRO DEVELOPERS

- Information Clearinghouse
- Newsletters
- Reconnaissance Surveys
- Application Assistance - DOE and FERC

PROGRAM OF ACTION

- Survey of Dams in North Carolina
- Analysis of Institutional/Regulatory Factors
- Provision of services to interested dam owners
- Other Efforts

SURVEY OF DAMS

- Data Sources
  - -N.C. Dam Safety Office
  - -Hydrologic Information Storage and Retrieval System (HISARS)
  - -U.S. Army Corps of Engineers
  - -FERC - retired plant list
  - -State historical surveys
  - -U.S. Geological Survey

- Analysis
  - -Dam height (head)
  - -Dam construction
  - -Stream location and flow
  - -Power potential calculation
  - -Power marketability/utilization

- Develop detailed list of dams
  - -Original list included 3,000-4,000 dams
  - -Contact owners of sites with significant power potential

-Finalized list of 275 dams with "best" development potential
-Data gaps currently being filled

ANALYSIS OF INSTITUTIONAL/REGULATORY FACTORS

- State Agencies concerned with:
  -Water Quality (-Sec. 401 Water Quality Certification)
  -Water Flow Regimes
  -Archaeological/Historical Resources
  -State Utilities Commission
  -Wildlife Resources (Threatened and Engangered Species)
  -Dam Safety

- Federal Agencies
  -Federal Energy Regulatory Commission (FERC)
  -U.S. Army Corps of Engineers
    Sec. 404 Dredge and Fill Permit
    Flood Plain Management
  -EPA

OTHER EFFORTS

- Preparation of a history of the development of hydropower in North Carolina
- Computerization of dam safety files with hydroelectric power potential calculations capabilities
- Hydroelectric power assessment for the N.C. Department of Administration and the Appalachian Regional Commission

SMALL DAMS IN NORTH CAROLINA

- With installed hydro
- Without installed hydro but with development potential

1. West Point on the Eno, Durham - hydromechanical
2. Lake Michie of Durham Water Supply Reservoir
   -licensed for 1500 kW, retired in 1963
   -80 foot dam
   -could provide up to 150 kW
3. Capitola Dam, French Broad River
   -8 feet

-1.5 MW

4. Lake Tohoma, Marion
   -65 Feet
   -240 kW installed, currently idle
5. Lake Lure
   -108 feet
   -3,600 kW installed - sell to Duke Power
6. Cascade Dam
   -Cascade Power Co. - receives 5 mills/kwh
   -1,000 kW installed
   -104 feet head - want to increase head
7. Cascade Dam Penstock
8. Gunpowder Creek, Granite Falls
   -75 feet
   -licensed for 400 kW; retired in 1967
   -City interested
9. Gunpowder Creek - Penstock
10. Burlington Mills, Second Broad River
    -About 500 kW potential
11. Cliffside Cone Mills, Second Broad River
    -32 feet
    -1625 kW installed but not used
12. Buckhorn, CP & L, Cape Fear River
    -licensed for 2900 kW, retired in 1962
    -25 feet
13. Pharr Yarns, McAdenville, S. Fork Catawba River
    -18 feet
14. Capelsie, Little River (cotton mill)
15. John H. Moss Lake, Kings Mountain
    -120 feet
    -617 potential
    -Buffalo Creek

THE ROLE OF THE LEGISLATURE IN THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER

Senator R. Ted Bottiger
Washington State

Energy is the foremost topic on today's public policy agenda. Almost every edition of every newspaper carries a first-page article on some aspect of the energy problem. The actions of an unstable Mid-Eastern government and a consortium of oil-producing countries have taken energy out of the Never-Never Land of esoteric academic research into the reality of long lines at the gas pumps and gas prices which have almost doubled in a span of a few months.

These problems may turn out to be a blessing in disguise. The public and its governments are now beginning to recognize that there is an energy crisis which will require the best of American ingenuity and self-sacrifice to resolve. There is a danger, however, that this intense concern about the petroleum situation will divert us from recognizing that our energy crisis spans the entire range of energy sources and uses. For example, I'd be willing to bet that everyone here, at some time during the past two or three months, has heard a statement to the effect that all we need to solve the gasoline problem is the electric car. I cringe when I hear statements like that because I know the dangerously thin ice we are treading in our electrical supply situation. Yes, electric cars would solve the gasoline problem. But before we head down that path, we'd better be sure we've got a solution to the electrical generation problem.

And that, of course, is what has brought us together here in Portland for the past two days -- the role of small-scale hydroelectric generation in meeting our future electrical supply needs and our role, as state legislators, in facilitating the development of this energy option.

To help focus my remarks, the conference organizers asked me to address four specific questions:

1. What position should renewable energy sources have on the energy agenda of the states?
2. What should be the role of the states' legislatures in facilitating the

development of renewable energy resources?

3. What are some of the actions that state legislatures can take in expediting development of small-scale hydroelectric power?
4. How can the State-Federal Assembly's Energy Committee of the NCSL assist in the development of small-scale hydroelectric power at the federal and state level?

Answering these questions is difficult and answering them in a general way is even more difficult. The role of renewables in a state's energy mix and the options for stimulating their development are very much a function of local conditions -- the climate, the topography, the economy, the regulatory environment, and even the local history. Therefore, at the risk of sounding parochial, I'll draw on what I know best -- the Northwest and, in particular, the State of Washington. I hope that some of this will be transferable to other states in the West and in the Nation.

Let's start with the first question. What position should renewable energy sources (and, in particular, small hydro) have on the energy agenda of the states? To begin to answer this question I'd first like to review the Northwest's energy history with you.

The Northwest is a region whose growth has, to a large part, been fueled by renewable energy resources. When one thinks of energy in the context of the Northwest, the image that is likely to come to mind is one of the mighty Columbia's waters rushing over a huge hydroelectric dam like Bonneville of Grand Coulee. These and similar dams built by the Corps of Engineers, the Bureau of Reclamation and many of the region's public and private utilities have provided the Northwest with a base of low cost hydroelectric power on which to build. Even today, hydroelectric power provides over 80 percent of the region's generation, even under low water conditions.

The availability of abundant, low-cost hydroelectric power attracted many energy-intensive industries and encouraged the use of electrical heating and other electrical conveniences such that per capita electrical consumption in many parts of the Northwest is twice the national average while rates are, in some instances, one-tenth those in some other parts of the country.

The end of this idyllic situation (some would say a fool's paradise) has unfortunately come into sight. Back in the early 1960's it became clear that demand was going to outrun supply of hydroelectric power and that the primary economically and environmentally feasible large hydro sites has been or soon would be developed. The only apparent alternative at that time was thermal power, coal or nuclear, with the emphasis on nuclear which was billed as being cheap, clean, and safe. Accordingly, Northwest utilities embarked on what by any standards is a massive construction project with, at present, nine nuclear and four coal plants at various stages of planning or construction.

I think we all know what has happpened during the construction of these plants. In some instances, initial cost estimates have escalated by almost a factor of three; scheduled completion dates have slipped three, four and even five years; and now the Three Mile Island incident has cast a further pall of doubt on the safety and economic viability of nuclear power to the extent that one federal energy official has declared that today the nuclear option in America is dead.

I think it is much too soon to reach that conclusion but it is clear that nuclear power has dealt itself a blow which will result in further delays and further cost increases for the plants now under construction. And, if I look at the utilities' forecasts of supply and demand for electricity in the Northwest, it is also clear that even with no further construction delays, the Northwest is running a high risk of being short of electricity throughout the early and mid-1980's.

What all this tells me is that we have to start looking for alternatives. Preferably alternatives which are proven technologies and which can be brought on line in a relatively short time, certainly less than the 10 to 14 years required for new central station thermal power plants.

What are the alternatives? I believe that at least part of the answer for our energy future can be found by examining our past. Take the old-fashioned virtue of thrift, for example. Translated into present day parlance, that's conservation. By far the cheapest and quickest new energy resource we have available is the energy we conserve -- if we can remove the legal, institutional and regulatory barriers which impede conservation. This is a goal we must all vigorously pursue. We must

recognize, however, that removing these barriers will be a difficult and time-consuming task. As an example, during the recent session, the Washington State Legislature voted to submit a constitutional amendment to the people in November which will permit publicly owned utilities to make conservation loans. It has taken two years to get it to this point. Moreover, we must also recognize that ultimately conservation is a "nonrenewable" energy resource. You can only become so energy efficient. Therefore, while we pursue conservation we must also be seeking new generation opportunities.

If I stick to my criteria of off-the-shelf technology and short lead times, a deeper look at our region's energy history leads me to two renewable generation alternatives -- wood waste cogeneration and small-scale hydro.

Before the days of Bonneville Dam and the BPA, the region's forest products industries were much more energy independent than today. Since they were blessed with an abundant fuel source in the form of wood wastes they burned those wastes to produce steam for their process needs and to generate electricity. Today, a recent study done for BPA identified the technical potential for 750 megawatts of cogenerated power in the region's forest products industry, much of which is very competitive with new central station thermal power.

Also before the days of Bonneville there was a considerable amount of hydroelectric generation in the region, most or all of which would qualify as small-scale under today's definition. An example is the 26 megawatt electron plant on Washington's Puyallup river. This plant was built in 1904 and is still operating today. An even smaller example is a hydro plant at the former Moran Estate (now Rosario Resort) on Orcas Island built in the early 1920's. This plant is still used to provide power for lighting at the resort.

Today the opportunities for small-scale hydro in the region are substantial. For example, a survey of undeveloped hydro potential performed by the Washington Water Research Center identified the potential for 7000 average megawatts of hydro generation on Washington's streams and rivers. Of course, not all this potential is developable. But, even if only ten percent could be developed it would represent a substantial addition to our electrical supply.

An even more likely prospect for new term development is the untapped hydro

potential at the region's existing dams and irrigation facilities. As you heard in this morning's case study, development has already begun on the first of several installations in Washington's Columbia Basin irrigation districts. In total, these facilities will yield over 100 megawatts of generation capacity. Just last Monday, I toured several potential irrigation hydro sites in our Yakima River Basin. These sites, if developed, would yield over 80 megawatts of winter-time generation. The estimated costs of power from these facilities is again very competitive with the cost of power from new central station thermal generating plants.

I would also mention that some of these projects let us have our cake and eat it, too. By enclosing and thereby pressurizing an existing open-channel irrigation system, it is possible to both conserve energy which has previously been used in pumping water out of the canals and also generate power. Overall, the result is a net gain of 6 MW of power.

All of this has been a rather long-winded way of saying that renewables, particularly wood waste cogeneration and small-scale hydro rate high on my unofficial energy agenda for Washington. It is likely that similar opportunities exist in other states in the Northwest. The question now is what do we need to do to translate the potential into reality?

What should be the role of the state legislatures in facilitating the development of renewable energy resources? I'm going to default on that question because it is too broad to answer in any meaningful way. As I indicated before, renewable energy resources are very technology specific and site specific. What constitutes appropriate legislative action for a given renewable resource in a given state depends very much on whether or not the resource is appropriate for use in that state, the stage of development of the technology (i.e., research, development, demonstration or commercialization) and the legal, institutional, regulatory and economic environment into which that technology is to be introduced. It makes little sense to establish incentives for commercializing a particular renewable if the technology for utilizing that resource is too immature. Such incentives may, in fact, be counter-productive if these technologies are rushed into the marketplace prematurely. Early failures often create a stigma which is difficult to overcome.

By the same token, funneling resources into research and development activities for renewable resource technologies which are well proven is an obvious waste, even though there will always be someone willing to perform yet another study.

Similarly, removing barriers to siting and licensing will have little effect if existing rate structures and regulatory provisions do not permit a new energy technology to compete at the margin. Very few, if any, new renewable energy technologies can compete with the low melded costs of electrical power in the Northwest because of the large base of existing low cost hydropower. Many, however, can compete effectively with the marginal costs of new power.

What I've been trying to say is that stimulating a new energy technology is a complex, "iffy" task. I'd venture to say every state represented here has passed some legislation aimed at stimulating one or more renewable energy technologies. I'd also bet that few of us know what effect, if any, those measures have had. That is not to say that such legislation is not needed and important. Rather, it emphasizes that it is important that legislation be well-reasoned, based on careful study of the technology and environment in which it is to be placed and built upon some understanding of what has and hasn't worked elsewhere and why.

Now let's move on to the third question and be more specific. What are some of the actions that state legislatures can take in expediting development of small-scale hydroelectric power? After all I've said about renewable energy technologies being site specific, I'm going to restrict my remarks to Washington State and hope that some of what I say is relevant to others. Also, much of what I have to say will be more raising of questions than providing definitive answers. Our analysis of small-scale hydro is really just beginning.

The design of policies aimed at stimulating a new energy source must start from what we know about it. Well, what is it that we know about small-scale hydro? For one, we know it is a proven, off-the-shelf technology. Even such so-called innovations as the bulb turbine have been in use in Europe for many years. We are clearly at a commercialization stage in the development of this technology and legislative action should be focused there.

Further, we know that hydro is capital intensive. The fuel costs may be small or nonexistent but the initial outlay is substantial. That ought to tell us some-

thing about how to stimulate small hydro.

We also know that even though hydro is a clean technology, there are environmental risks. New impoundments can disrupt important runs of salmon and steelhead, ruin spawning grounds, inundate wildlife habitat and impact on other uses of the land. Diversions from streams and rivers can reduce flows to levels which harm fisheries and commerce and impinge on downstream uses. The risks are obviously smaller with small-scale hydro but they are still there. It is clear, therefore, that measures undertaken to ease the burden of siting and licensing small-scale hydro facilities must carefully balance the benefits to be derived from power development against a variety of environmental and social costs. It is also clear that there is probably a large body of law already on the books aimed at protecting those social and environmental values which may not have taken the possibility of small hydro properly into account.

Finally, we also know that because of the decentralized nature of small-scale hydro, the extent of the resource in terms of viable sites is not well known. I mentioned earlier a study in Washington which identified an undeveloped potential of 7000 megawatts. That was determined using existing hydrological data and topographical maps. It is now necessary to go from this data base into the field to actually identifying viable small-scale hydro sites. There is the potential for the legislature to have a positive impact on small-scale hydro development by sponsoring definition of the state's resources and disseminating that information broadly.

Now some specific examples. Earlier I mentioned institutional barriers. One such barrier was encountered in investigating the feasibility of developing the hydroelectric potential of the state's irrigation systems. It was found that irrigation districts did not have the statutory authority to enter into long term contracts for the sale of power from generating facilities that they own or to issue long term revenue bonds to finance the construction of generating facilities. As a result, they were unable to get favorable financing terms to develop their hydro potential. Action by the legislature during the last session removed this barrier to permit development to go ahead.

The burden of siting and licensing procedures is often mentioned as a major impediment to energy development of all kinds. On my recent tour of potential hydro

sites in the Yakima Irrigation District, I asked how long it would take to bring a particular 12 megawatt site on line. The answer was five years -- two years for engineering and construction and three years of environmental reports, licensing and permitting procedures. If this is true, the burden of siting and licensing is proportionately much greater on small hydro than it is on large coal or nuclear power plants.

My initial reaction was that most of that delay was probably at the federal level. However, Ron Corso tells me that FERC defers to the state licensing and permitting process. If that is that case, we had better make sure that our own house is in order. We did a little research and came up with the following list of licenses, permits and procedures required in Washington State.

1. Development of an environmental checklist to determine if a full scale environmental impact statement is required pursuant to the State Environment Policy Act;
2. Preparation of the environmental impact statement if the above determination is positive, complete with public hearings and agency review;
3. Obtaining a shoreline development permit pursuant to the State Shoreline Management Act;
4. Apply for dam safety approval from the State Department of Ecology;
5. Obtaining a water rights permit or modifying the existing permit;
6. Obtaining a reservoir permit;
7. Obtaining a power license (and paying the fee which for a ten megawatt plant would be $342 each year);
8. Obtaining a flood control permit;
9. Obtaining a water quality certificate; and
10. Obtaining a hydraulic project approval from both the Departments of Fisheries and Game.

This is a mind-boggling list which certainly requires a substantial investment of time and effort to satisfy. I quite frankly do not know the extent to which these requirements are a significant impediment to developing small-scale hydro. However, I intend to find out. We need to determine if all these requirements and the costs they impose on the developer are justified by the social and environmental benefits they secure and if there are ways to streamline the process. We do have something called the Environmental Procedures Coordination Act which does establish

our Department of Ecology as the permit coordinating agency. This doesn't reduce the member of hurdles to be leaped. It does, however, provide a central point from which the developer can get all the necessary forms and to which he can return them. I suspect we have to do better than that.

Washington has an Energy Facilities Site Evaluation Council (EFSEC) which is a so-called "one stop" siting process for major energy facilities. EFSEC brings together all the agencies and local governments who are party to siting and permitting an energy facility to determine the suitability of a proposed site. A key feature of EFSEC is the "early no" which attempts to tell the developer as soon as possible when a site will not be approved. Perhaps we need a "mini-EFSEC" for small hydro and other small scale energy options.

Another potential problem I discovered yesterday is that Washington requires that the environmental impact statement be written before application for the FERC license can be made. This would be OK if the state EIS could then be used by FERC. But, apparently Washington routinely intervenes in the FERC licensing process which then disqualifies the state EIS from adoption by FERC. The result is EIS double jeopardy.

There may be good reason for this. Right now I don't know. But I intend to find out.

Yet another potential problem for licensing small hydro in Washington stems from the fact that our Department of Ecology is currently working on establishing minimum base flows for western Washington rivers pursuant to earlier legislative mandates. Clearly, the level at which these flows are set will affect the viability of many small scale hydro sites. Again, I don't know if this really is a problem, but I'm sure going to find out.

Let me end by response to this question on a positive note. Earlier, I mentioned the need to better define where the viable small hydro sites are and to disseminate that information to potential developers. Shortly, such a project will get underway in Washington with DOE funding. The legislature, with the very substantial help of NCSL, was instrumental in getting this project going and I'm confident that we'll eventually get some new small hydro development as a result.

These are just a few areas in which legislative action has been or may be required to facilitate small hydro development in Washington. I'm sure we will find more as we study this subject further. I hope our experience will be of some value to others.

Finally, the last question. How can NCSL's Energy Committee assist in developing small-scale hydro at the state and federal levels? At the state level, conferences such as this and the technical assistance program NCSL has underway in several states should prove, I believe, to be of tremendous value. We, the states, need to come together and share our experiences, both successes and failures. We need to exchange information and NCSL is an effective conduit for that exchange.

At the federal level, probably the most important service NCSL can provide is to represent the states' concerns in several important areas.

One of these areas concerns federal grants and/or loans for small hydro development.

It may be heresay to say this, but sometimes I feel that the lure of federal money is more disruptive than productive. The announcement of a new grant or loan program brings all productive work to a halt while voluminous proposals and applications are prepared. Usually only a small percentage of these applications can be funded and often the ones that are funded could probably have made it on their own. The ones that don't have lost valuable time and resources and may founder as a result. But, hydro is capital intensive so I suspect some form of federal assistance is needed. I have the following suggestions for improving the effectiveness of that assistance:

1. Remove all the phoney distinctions about low head, existing facilities, less than 20 meters, etc., come up with a workable definition of small hydro and let's get on with it. How does anything less than 50 MW strike you?

2. I think there is greater leverage in funding feasibility studies than in funding actual development. Once a project has been shown to be feasible, funding shouldn't be a problem. A good, cost-competitive generation opportunity should be able to attract capital.

I heard a suggestion yesterday that federal guarantee of the private construction bonds would be another way of leveraging federal dollars to achieve more small hydro. I know that federal guarantees in the form of BPA guaranteed purchase has been an important factor in energy development in Washington, Oregon, Idaho and Montana and is probably the key factor behind the regional power bill. This has proved effective and perhaps loan guarantees could be made widely available for development of small scale renewables.

A second area of concern is that I believe that wherever possible, actual development should be left to local entities, not the federal agencies. I have a little bet going as to who is going to get a small hydro project on-line in Washington first -- the Bureau of Reclamation or one of our irrigation districts. I needn't tell you where my money is. More can be achieved by having the federal agencies help the local developer than by competing with him.

In the area of federal licensing and environmental procedures, what I said with regard to the states applies equally if not more so for the feds. The Federal Energy Regulatory Commission (FERC) has improved the situation somewhat with regard to their licensing requirements for small hydro. There remains, however, a complex web of federal requirements and departments which confronts the potential developer. The burden this places on the developer of a small facility may be enough to remove a project from the realm of the feasible. Just as we need to examine the need for streamlining procedures at the state level, we must urge the federal government to do the same. The alternative may be to pass up a viable renewable energy resource we can ill afford to lose.

Finally, a point of particular concern to Washington, Oregon, Idaho and Montana. That concerns resolution of the regional power issue that has been before Congress for almost two years now. Those of you from outside this region may not fully appreciate the role BPA plays in the development of resources in the Northwest. The uncertainty of the present situation -- will BPA supply future load growth, will BPA purchase resources -- I'm sure has some potential developers on the sidelines.

The regional power issue is extremely complex. An ad-hoc committee of state legislators on Northwest power convened by the Council of State Governments has been meeting periodically to develop input on this issue and will be meeting again

tomorrow. I will not attempt a tutorial on this subject. Let me say that it is my belief that there are some pitfalls associated with BPA guaranteed purchase. However, with the proper mandate, the proper constraints and the proper degree of participation by the states of the region in key decisions, more conservation and more renewable resource development will occur with BPA than without it. We must resolve this issue and get on with the job at hand.

ENERGY BRIEF: PACIFIC NORTHWEST, INCLUDING CALIFORNIA

U.S. Army Corps of Engineers
Small-Scale Hydroelectric Power Resources

INTRODUCTION

Since the completion of the world's first hydroelectric central generating station at Fox River in Appleton, Wisconsin in 1882, hydroelectric power has played a significant role in the electrification and industrialization of our nation. Although this first plant was small (providing only enough capacity to light 250 lightbulbs), it had a large impact, as streams and rivers across the country were rapidly developed to generate electricity. Today hydropower provides about 13 percent of the nation's total electric power with an installed capacity of about 60,000 megawatts and an average annual energy generation of about 280 billion KWH/year.

The growth of hydropower development was rapid during the first half of the twentieth century, but by the mid-1960's many factors had combined to diminish the role of hydropower in most electrical utility systems. First, as was natural, the better sites were developed early and the undeveloped potential simply did not look as attractive compared to other available energy alternatives. Second, demand for electrical energy increased rapidly during the 50's and 60's and it appeared certain that even with continued development of new sites, hydropower's "share of the load" would steadily decrease. Finally, low fossil fuel costs and optimistic forecasts concerning nuclear generation technology and acceptability led many to believe that the nation's energy future was secure.

During the past decade, a number of factors, including steady increases in fossil fuel costs, rapid inflation of the costs of constructing thermal generation facilities, and increased public concern over the safety of nuclear generation have prompted not only a search for new energy alternatives, but also a reexamination of previously ignored or discounted alternatives.

The U.S. Army Corps of Engineers involvement in studying the nation's small-scale hydroelectric power potential dates from President Carter's Energy Plan of 1977. This plan specifically recognized the potential for redeveloping small-scale hydroelectric power as an alternative energy resource, and the President

directed the Corps of Engineers to produce summary estimates of its energy potential at existing sites across the nation.

The directive led to the Corps' preliminary 90-day hydropower study which was published by the Institute for Water Resources in 1977. This report was the first to produce comprehensive estimates of the hydropower potential at existing sites, and also identified the major social, economic, institutional and environmental constraints which might preclude full development of the potential. The study provided preliminary information on the regional distribution of the resource, and identified key areas of the country where small-scale hydropower development could potentially reduce dependence on fossil fuels as a source of energy generation, It is important to note that these earlier estimates of the small-scale potential were made on the basis of a prototype analysis and that they were not based on data from site-specific investigations.

Since publication of this study, the Institute for Water Resources has been actively engaged in a congressionally authorized National Hydroelectric Power Resources Study. When completed in 1981, the study will provide a more detailed evaluation of the nation's hydroelectric power resources at both existing and undeveloped sites, including small-scale facilities. The small-scale component of the study is jointly funded by the U.S. Department of Energy.

METHODS OF STUDY

For the purpose of this study, a small-scale hydroelectric power site is defined as an existing facility with a capacity potential of no more than 15 MW. There is no upper limit on height of dam. In addition, the study identifies potentially feasible, undeveloped sites where no dam or other engineering structure presently exists. The inventory contains information on a great variety of sites including those which were originally developed for hydroelectric power, flood control, recreation, water supply or other water resource projects.

The basic inventory of small-scale sites was designed to follow the general format and data requirements used by the Corps in its Inventory of Dams in the United States. Thus, the initial inventory contained information on approximately 50,000 sites, of which some 47,000 were classified as small-scale facilities. These data were supplemented with additional information obtained from a number of local, state and Federal water resource development agencies. Corps field

offices screened all sites in the original data base to eliminate those without sufficient storage, head or streamflow to generate a significant amount of electricity (lower limit = 50 KW). Similar information was collected and calculated to determine the physical potential of undeveloped sites across the nation. Additional data, including refined streamflow estimates, physical and hydraulic site characteristics, and field reports of existing and potential capacity were collected for all sites in the inventory to provide specific estimates of their potential.

RESOURCE ASSESSMENT

National Potential

At the present time, the Corps has identified approximately 5,600 existing small-scale dams in the country which are either generating power, or have the potential for new or increased capacity. The total installed capacity at existing dams in the small-scale category is estimated to be about 2,500 NW with an average annual energy of nearly 13,000 GWH. This is about 5% of the nation's installed capacity and average annual generation. New or additional capacity totaling about 5,700 MW could be installed at nearly 90 percent of the existing small-scale dams. These installations could potentially produce about 17,000 GWH of energy annually. In addition, about 2,500 undeveloped sites have been identified which could provide another 7,600 MW of capacity and 27,000 GWH of energy. It is important to note that these figures are preliminary, and that the totals do not include a number of sites which are still being analyzed. Refined estimates of the total hydropower potential at small-scale dams will be issued as the data base becomes more complete.

The amount and regional distribution of the small-scale hydropower resource varies considerably across the nation. The distribution of the existing sites closely reflects an interaction between climatic variables, landforms and settlement history. The largest number and density of small dams occur in the Pacific Northwest and New England states. This pattern results from the traditional reliance that both regions have had on hydropower energy generation, Many of the sites are located near population and industrial centers where existing transmission interties are relatively well developed. Other areas with a high potential for new or additional hydropower development include much of the Midwest along the Great Lakes and the Mid-Atlantic states. Regions with the highest

average installed capacity per site include Alaska and the Pacific Northwest; this distribution reflects the large number of small, high head sites found throughout these areas.

Pacific Northwest

Table 1 summarizes the existing, additional or incremental, and undeveloped small-scale hydropower potential in Pacific Northwest, including Alaska and California. Figure 1 shows the regional distribution of the small-scale potential in the states of California, Idaho, Montana, Oregon, Washington, and Wyoming. Appendix 1 is a more detailed tabulation of the potential in the respective states with the data grouped in various hydraulic head and capacity ranges. These data were compiled from local and regional investigations made by the Corps' North Pacific Division and the South Pacific Division.

The Corps' inventory of existing and undeveloped hydroelectric power in the Pacific Northwest, including California shows an overall small-scale potential of 6,012 megawatts (MW) with an estimated average annual energy generation of some 25,000 gigawatt-hours (GWH). Approximately 754 MW, or 39 percent of the total resource at existing dams or other impoundments has already been developed in the region. The remainder (5,258 MW) represents the maximum potential which could be developed by upgrading and expanding existing projects and by constructing hydropower facilities at undeveloped sites.

Most of the available energy generated at existing dams is found in California, Washington, and Idaho with smaller totals in Oregon, Alaska, Montana and Wyoming, respectively. All states have the potential for additional or incremental development at existing projects with California and Oregon having the largest estimates. The undeveloped resource varies considerably throughout the region, but the potential is greatest in Oregon and Alaska.

By comparison, Table 2 summarizes the total existing, additional or incremental, and undeveloped hydroelectric power potential at both large and small-scale sites in this region. The overall potential is estimated to be 330,295 MW capable of generating an average of about 873,640 GWH annually. Most of the current installed capacity is found in the states of California, Oregon and Washington. The potential for additional or incremental capacity at existing projects is similar to that reported for small-scale sites with Oregon and Washington having the largest

estimates. As expected the undeveloped resource varies widely with Alaska showing the greatest potential. In this regard, the undeveloped capacity in Alaska represents more than a third of that estimated for the entire United States.

It is important to note that these preliminary data represent the maximum physical hydroelectric power potential which could theoretically be developed. The estimates of additional or incremental, and undeveloped potential do not specifically consider the social, economic, institutional and environmental constraints which could preclude full development of the hydropower potential. Future investigation by the Corps and other local, state and Federal agencies will continue to refine the economic feasibility and actual generating capacity of the most favorable sites contained in the inventory.

To assist energy planners at all levels of orgainzation, the Corps of Engineers will publish a public information file of all potentially feasible hydropower sites in the inventory on a state-wide basis. The file will include site-specific geographic information, project purpose and ownership references, refined streamflow and hydraulic information, and estimated capacity and energy values. Publication of the file will be completed by the end of July, 1979. Appendix 2 is a sample of the public information file for the state of Oregon.

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WORKSHOP SUMMARIES: NATURAL RESOURCES AND ENVIRONMENTAL ISSUES

Workshops on the impact of small-scale hydroelectric development on natural resources and the environment were lead by Richard Cellarius, Sierra Club Board of Directors, and Steven Hildebrand, Oak Ridge National Laboratory.

In addition to exploring the probable environmental impact of small-scale hydro, workshop members discussed the laws which affect resource development.

During the workshops lead by Mr. Cellarius discussion focused on the many institutional barriers or checkpoints that a small-scale hydroelectric developer must contend with in the environmental review process.

At the beginning of each of his workshops, Mr. Hildebrand listed potentially significant environmental issues and explained the impact of small-scale hydro on them. The groups were then asked to add or remove issues from the list, and where possible, put them in order of priority.

RICHARD CELLARIUS, Sierra Club Board of Directors

The most predominant theme was the threefold problem of 1) having to deal with both state and federal environmental review processes, 2) the multitude of state agencies that must be dealt with and, 3) the time delays involved in dealing with all these requirements. Among the solutions proposed were the following (not necessarily in order of importance).

1) Set up a small-scale hydro "ombudsman" office at the state level which might coordinate obtaining state

approvals or at a minimum be a single source of information on the necessary steps, with perhaps a 2-3 page guide or "cookbook" on how to license a project complete with addresses and phone numbers.

2) Have State Energy Facility Site Evaluation Councils (EFSEC's) also handle small-scale hydro. In Washington EFSEC only considers projects greater than 250 MW and does not deal with hydro at all. There was some question whether such councils really have resulted in speeding up the process, however.

3) Eliminate either the state EIS when a federal one is required or ask the federal government to authorize the states to grant the final permits (analogous to the way NPDES permits are handled). For the ledger, states would need to develop their own permit processes to meet federal guidelines.

Corollary to (1) and (3): Designate one state agency as the lead agency for dealing with water projects and assuring all competing needs are considered and to make the final judgement of what is in the best public interest - the way FERC does (or is supposed to do) at the federal level. Some states have done this by agency designation or by establishing state water commissions. There was some disagreement as to their success. There was also discussion of having FERC get involved early in the state proceedings on the suggestion that FERC "circuit ride", holding its proceedings in the various states rather than only in Washington D.C..

4) Develop clear standards for negative declaration of environmental impact for small projects and expedite the reviewing process so that developers do not get bogged down in the bureacracy.

STEVEN G. HILDEBRAND, Oak Ridge National Laboratory

At the beginning of each session, Mr. Hildebrand listed and explained potentially significant environmental issues. The group was then asked to add or remove issues from the list, and where possible prioritize issues. The final 45 minutes of each session were devoted to policy or solution recommendations. The summary presented below is an integration of the discussions generated in the three workshop sessions. Judgments about consensus of participants are subjective impressions by the workshop leader and rapporteur.

Environmental Issues Potentially of Concern Affecting Small-Scale Hydroelectric Development

1. How to insure public involvement at the front end of development efforts to identify significant environmental issues requiring mediation and mitigation?
2. Requirements for fish passage facilities (both upstream and downstream) at existing dams. How are requirements determined and who assumes the financial burden?
3. Water released from the bottom layer of stratified impoundments that may be low in dissolved oxygen, contain elevated levels of iron, manganese, or other elements in solution, and present an altered thermal regime generated concern about effects on downstream ecosystems.
4. Minimum/Optimum flow requirements below dam systems. Concern was raised relating to fish and wildlife habitat and downstream water use.
   Water level fluctuation associated with hydroelectric operation and resultant effects on fish spawning and biological productivity.

The suggestion of straight exemptions for projects below a minimum size was countered with the comment that there is no minumum size for exterminating an endangered species.

5) To deal with time delays
   a) Start the environmental assessment along with the economic and engineering feasibility studies.
   b) Involve the public early, with clear time limits on appeals, etc.
   c) Coordinate involvement of various interest groups so they don't individually and sequentially go to court. A state-sponsored mediation service for getting conflicting groups talking to each other and working with the project sponsors was also suggested.

Two other things are worth mentioning briefly: 1) For small projects the costs of environmental assessment may be disproportionately large - as is the cost of the entire licensing procedure. More simplification of the licensing procedure would help the latter problem. There was no clear solution to reducing the cost of environmental assessment suggested, 2) In at least two sessions the problem of overall public resistance to any dam and the need for a public education program were discussed. To assure some confidence that not every stream was going to be dammed eventually, it was suggested that the development of a state energy policy, which would give the public some sense of how many, what kind of projects and where they would be placed, should be done. It was also suggested that this would be politically impossible because it would involve discussion of life styles, controls on growth, etc. Apparently few politicians are willing to touch such topics

ECONOMIC WORKSHOPS

The Economic Workshops were conducted by David Auslam, President Auslam and Associates, and David Willer, Tudor Engineering.

The purpose of the economic workshops was to decide what determines the economic feasibility of a small-scale hydroelectric site.

In Mr. Auslam's workshop participants raised the following economic and financial issues:

1) The licensing process needs to be streamlined. Some suggestions were:
   -- One-stop state and federal licensing
   -- Clearinghouse for information
   -- Coordination between federal, state and local agencies.

2) The early capital costs and risks at the feasibility level need to be reduced to acceptable levels. Suggestions were:
   -- Capacity credits in power contracts
   -- Establishment of DOE loan program (information presented by DOE at one workshop indicated that one DOE loan program soon will make available $10 million for feasibility studies. The program would allow for a minimum of $50 thousand per project with forgiveness if the project proves to be unfeasible).
   -- Allow for an additional 10 percent investment tax credit to put small hydro on the same level as other alternative energy sources such as solar. Solar projects currently receive a 20 percent credit.
   -- Defer sales and property taxes similar to a program established by the Department of Economic Development in the State of Washington.

3) Developers need relief from public intervention. Some suggestions were:
   -- Require intervenors to submit environmental impact statements
   -- Require intervenors to post performance bonds
   -- Insure that intervention is undertaken in a timely fashion and that only substantial reasons for intervention are allowed
   -- Insure that the public is properly educated during the early stages of the project so that problems can be identified.

4) There is a need to clarify the pricing of small hydro and to guarantee wheeling for on-line projects. The creation of a centralized power wholesaling authority to mediate pricing and wheeling disputes was suggested.

5) Key to obtaining financing through bonds is meeting debt service over the life of the project. Two suggestions for accomplishing this were:
   -- Requiring utilities to provide for capacity credits when justified
   -- Implementating the share savings marketing concept where profits and losses are pooled and shared by both developer and purchaser

6) It was agreed that state and federal assistance in locating and determing economic feasibility of small hydro projects would be highly desirable. Besides identifying sites, it was suggested that states determine minimum in-stream flow requirements for all waterways.

7) National energy policy needs to be clearly identified, stated and strictly enforced.

8) All information provided by both the public and private sector related to determining the feasibility of small hydro should be clearly differentiated between new and existing sites because of the economic and environmental impacts that could be expected from one versus the other.

9) It was suggested that the government and other U.S. developers investigate small hydro in other countries where it has been a viable energy source for many decades.

In Mr. Willer's workshops participants discussed the following issues and recommended policy options:

1) There appears to be no coordinated federal government policy which addresses itself to minimizing problems for the small-scale hydroelectric developer. Suggestion was:
   -- An active, coordinated inter-agency policy would be extremely helpful to the small-scale hydroelectric developer. There is the possibility that the new Rural Energy Initiative being extablished by the Executive Branch could provide a mechanism to answer some of these problems.

2) Federal and state licensing procedures are cumbersome and cause delay, which means due expense for the developer. Suggestion was:
   -- Granting or permitting of licenses by default if appropriate action is not taken by the licensing agency after a reasonable time for review. Also, providing one-stop licensing and permitting offices would help facilitate the process.

3) Some mechanism should be initiated so that small-scale hydroelectric developers would be receiving a fair and

reasonable rate from the purchasing utilities for the power to be generated. Suggestion was:

- State PUC's should set rates which reflect the highest alternative incremental cost for capacity and energy

4) High initial capital construction costs act as an economic barrier to the small-scale hydroelectric developer. Suggestion was:

- Make more state and federal loan money available with guarantees in case of higher production cost in early years versus revenue from power sales.

5) Low interest loans for initial financing of small-scale hydroelectric projects are needed. Suggestion was:

- Provide more low interest loans or grants for feasibility studies and for developing the site specific project.

6) Tax exempt financing for sale of power to IOU's and federal government agencies from small-scale hydroelectric development is needed to promote further hydroelectric projects. Suggestion was:

- Change or modify section 103C, Internal Revenue Service Codes.

7) Intervenors should be made liable for delays caused in licensing of a small-scale hydro project. Suggestion was:

- Performance bond requirement/additional issues without policy options which were considered are as follows:

8) The Bureau of Reclamation should expand their power generating capability on federal projects. This, however, favors western states over eastern states where no BurRec projects exist.

9) Determination of the "value of power" should be clarified since this has a direct effect on the feasibility study's cost-benefit ratio.

10) More developers would be interested in federal projects if they know what the federal charges for the use of the falling water would be.

11) Marketing of power in competition with the federal government and their low costs. This acts as a disincentive to municipalities because whatever quantity of power that might be developed will be subtracted from their account with Bonneville Power Administration. What this means economically is the municipality is paying mor for energy than it produces and it loses inexpensive BPA energy.

The state/federal workshops were lead by Professor Peter Brown, Director, Energy Law Institute, the Franklin Pierce Law Center and Anthony Buxton, Esquire, Senior Research Fellow, the FPLC. The workshops outlined current state roles in hydro licensing and development and placed the federal regulatory role in perspective.

In Mr. Buxton's workshop participants felt western water law does not present a barrier to small-scale hydroelectric development. Participants considered hydroelectric generation a beneficial use under state law. To overcome licensing problems most participants favored a lead agency rather than a one-stop process which would still involve multiple agencies. Rather than establish a general time limit rule for licensing, each project should be considered separately.

The lead agency should be the single decisionmaker and should consider both energy benefits and environmental costs. Participants favored the creation of a hydro ombudsman in each state to speed licensing approval.

It was felt that small-scale hydroelectric development should not be subjected to traditional public utility certification of of public convenience. There was strong support for the states to enact "mini-PURPA's to extend the benefits of wheeling and interconnection to public entities not covered in PURPA.

In Professor Brown's workshops a consensus was reached on several issues. Participants felt that there were no problems under the appropriation doctrine. However, several conferees did indicate that certain developments in various western states could create future problems with the water law affecting small-scale hydro.

With respect to state licensing systems, a strong majority felt that the states should expedite the licensing process by adopting a one-stop or lead agency licensing process. All workshop participants agreed that whatever the licensing agency might be, it should adhere to the following guidelines:

--early notice of project proposal to interested agencies, local governments and public interest groups

--"an early no" decision to developers and a scoping session to identify additional information needs early in project development

--there should be an application form to complete

--there should be strict deadlines and a waiver of objections if the agency does not respond promptly to a licensing application

--states should adopt the FERC Environmental Impact Statement when FERC prepares an EIS

Some participants felt that FERC should not license small-scale hydroelectric projects of 25 MW or less provided the state licensing process meets FERC criteria and standards.

It was agreed that Congress should delegate authority to the FERC to make a "declaration of non-significance" for small-scale hydroelectric projects at new and existing sites early in the licensing process. However, members felt that FERC should still be required to confer with the same departments it consults on environmental matters.

There was a consensus that Congress should clarify the jurisdictional division among the Departments of Interior and Agriculture under such legislation as the Federal Land Policy Management Act.

The opinion was also voiced that the Pacific Northwest Power Legislation presently pending in Congress be promptly enacted to provide some certainty to regional utility planning.

PLENARY SESSION

Senator Paul Hess was moderator for the Friday afternoon plenary session. The panel represented different organizations and agencies which gave the representatives an opportunity to comment directly on small-scale hydroelectric power in the Pacific Northwest and to respond to conferees' questions and comments.

RONALD CORSO, Federal Energy Regulatory Commission

Mr. Corso felt that both federal and state bureaucrats must be held more accountable for their actions, and not "over-regulate", and not compromise legitimate concerns.

He felt that a lead agency concept offered real opportunity for small-scale hydroelectric dam developers and that the new FERC regulations represented a positive effort to expedite the licensing process. He also felt that small-scale hydro had been given short shrift by not receiving the same attention in financial incentives as had other renewable energy sources. Mr. Corso thought it was important to distinguish between the size and scale of a project when regulations and licensing were considered. He urged developers to apply for preliminary permits and to seek FERC staff assistance.

BOB McKINNEY, Cowlitz Public Utility, Longview, Washington

Mr. McKinney represented a countywide consumer-owned utility and a service area with four large rivers with site-specific conditions. He supported small-scale hydro as an important energy alternative and expressed a concern that it be equally evaluated and compared with other alternatives, especially by the media.

He urged more public participation and public education to insure acceptability of small-scale hydro projects. He discussed the problems of his utility regarding riparian and residential land affected by hydro development.

SENATOR TED BOTTIGER, Chairman, State Energy Committee, Washington

Senator Bottiger encouraged state legislators to authorize analyses of their respective state regulatory systems as they affect small-scale hydro development.

He had accumulated a list of issues to discuss with his legislative staff and energy committee as a result of the conference, and announced that he would review the steps and requirements for small-scale hydro developers in his state.

JOHN LOBDELL, Commissioner, Oregon Public Utility Commission

As the sole member of Oregon's PSC, Mr. Lobdell emphasized the need for public acceptance of a small-scale hydro project. He feels the public does not have sufficient information to properly evaluate the subject of small-scale hydro at this time and faults politicians and state agency staff.

NELS ANDERSON, State Representative, Alaska

Representative Anderson addressed the unique problem of his state; despite its natural resource development, Alaska is in its infancy with respect to power production. Relying totally on fossil fuel presents a problem because of the state's immense size. Since Alaska is not directly benefiting from its oil production several legislative committees are reviewing small-scale hydro development possibilities. Representative Anderson asked for support in the resolution of D-2 land legislation so that hydro development could proceed.

ROBERT LEE, Manager of Hydro Production, Portland General Electric Corporation and Vice-Chairman of the Hydro Power Committee of the Edison Electric Institute

Mr. Lee spoke about the overlap in federal codes and regulations and said that the states had the same problem. If the states cannot streamline the permitting process then the federal government should preempt the states in order to get the process started. He also felt that the

development of small-scale hydro is being constrained because most good sites without fish passage problems have already been developed. Mr. Lee alluded to the problems of insurance liability, environmental and recreational use competition with power production, and the impact of operation and maintenance. He advised that these problems be taken very seriously.

After panel members were questioned by conferees during the open discussion period, Senator Hess and NCSL Project Director Ron Smith urged policymakers, developers, and the public to participate in the development of small-scale hydro resources. The Conference was then adjourned.

APPENDICES

LIST OF ATTENDEES

SMALL-SCALE HYDROELECTRIC POWER
IN THE PACIFIC NORTHWEST:
New Impetus For An Old Energy Source

Portland, Oregon
July 12 - 13, 1979

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