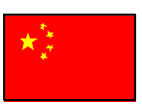
Survey of existing guidelines, legislative framework and standard procedures for EIA of hydropower projects

IEA Technical Report

IEA Hydropower Agreement


CANADA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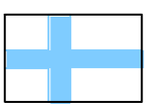
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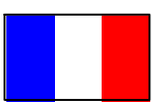
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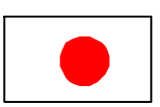
JAPAN


NORWAY


SPAIN


SWEDEN


UNITED KINGDOM

OVERVIEW OF THE IEA IMPLEMENTING AGREEMENT FOR HYDROPOWER TECHNOLOGIES AND PROGRAMMES

The Hydropower Implementing Agreement is a collaborative programme among nine countries: Canada, China, Finland, France, Japan, Norway, Spain, Sweden and the United Kingdom. These countries are represented by various organizations including electric utilities, government departments and regulatory organizations, electricity research organizations, and universities. The overall objective is to improve both technical and institutional aspects of the existing hydropower industry, and to increase the future deployment of hydropower in an environmentally and socially responsible manner.

HYDROPOWER

Hydropower is the only renewable energy technology which is presently commercially viable on a large scale. It has four major advantages: it is renewable, it produces negligible amounts of greenhouse gases, it is the least costly way of storing large amounts of electricity, and it can easily adjust the amount of electricity produced to the amount demanded by consumers. Hydropower accounts for about 17 % of global generating capacity, and about 20 % of the energy produced each year.

ACTIVITIES

Four tasks are operational, they are: 1. upgrading of hydropower installations, 2. small scale hydropower, 3. environmental and social impacts of hydropower, and 4. training in hydropower. Most tasks will take five years to complete, they started in March 1994 and the results are expected in 1999. To date, the work and publications of the Agreement have been aimed at professionals in the respective fields.

UPGRADING

The upgrading of existing hydropower installations is by far the lowest cost renewable energy available today. It can sometimes provide additional energy at less than one tenth the cost of a new project. One task force of the Agreement is studying certain technical issues related to upgrading projects.

SMALL SCALE HYDROPOWER

Advances in fully automated hydropower installations and reductions in manufacturing costs have made small scale hydropower increasingly attractive. The small scale hydropower task force will provide supporting information to facilitate the development of new projects.

ENVIRONMENTAL AND SOCIAL ISSUES

For some hydropower projects the environmental and social impacts have been the subject of vigorous debate. There is a need to communicate objective information to the public, so that countries can make good decisions with respect to hydropower projects. The environmental task force will provide such information on possible social and environmental impacts and on mitigation measures.

TRAINING

The availability of well-trained personnel is a key requirement in the hydropower sector. The training task force is concentrating on training in operations and maintenance, and planning of hydro power projects.

THE INTERNATIONAL ENERGY AGENCY – IMPLEMENTING AGREEMENT FOR HYDROPOWER TECHNOLOGIES AND PROGRAMMES

SURVEY OF EXISTING GUIDELINES, LEGISLATIVE FRAMEWORK AND STANDARD PROCEDURES FOR EIA OF HYDROPOWER PROJECTS

The views presented in this report do not necessarily represent the views of the International Energy Agency, nor the governments represented therein.

May 2000

OTHER TECHNICAL REPORTS IN THIS SERIES

HYDRO POWER UPGRADING TASK FORCE (ANNEX 1)

Guidelines on Methodology for Hydroelectric Turbine Upgrading by Runner Replacement – 1998 (available to non-participants at a cost of US $ 1,000 per copy)

Guidelines on Methodology for the Upgrading of Hydroelectric Generators – to be completed in May 2000.

Guidelines on Methodology for the Upgrading of Hydropower Control Systems – to be completed in 2000.

SMALL SCALE HYDRO POWER TASK FORCE (ANNEX 2)

Small Scale Hydro Assessment Methodologies – to be completed in May 2000 (available to non-participants on request)

Research and Development Priorities for Small Scale Hydro Projects – to be completed in May 2000 (available to non-participants on request)

Financing Options for Small Scale Hydro Projects – to be completed in May 2000 (available to non-participants on request)

Global database on small hydro sites available on the Internet at:
www.small-hydro.com

ENVIRONMENT TASK FORCE (ANNEX 3)

Survey of the environmental and social impacts and the effectiveness of mitigation measures in hydropower development – 2000 (available to non-participants on request)

Environmental comparison between hydropower and other energy sources for electricity generation – 2000 (available to non-participants on request)

Survey of existing guidelines, legislative framework and standard procedures for environmental impact assessment related to hydropower development – 2000 (available to non-participants on request)

Present Context and Guidelines for Future Action
Volume 1: Summary and Recommendations
Volume 2: Main Report
Volume 3: Appendices
– 2000 (available to non-participants on request)

Effectiveness of Mitigation Measures – 2000 (available to non-participants on request)

EDUCATION AND TRAINING TASK FORCE (ANNEX 5)

(All of the following reports are available on the Internet at www.annexv.iea.org Some reports may consist of more than one volume.)

Summary of Results of the Survey of Current Education and Training Practices in Operation and Maintenance – 1998 (available to non-participants on request)

Development of Recommendations and Methods for Education and Training in Hydropower Operation and Maintenance - 2000 (available to non-participants on request)

Survey of Current Education and Training Practice in Hydropower Planning – 1998 (available to non-participants on request)

Structuring of Education and Training Programmes in Hydropower Planning, and Recommendations on Teaching Material and Reference Literature - 2000 (available to non-participants on request)

Guidelines for Creation of Digital Lectures – 2000 (available to non-participants on request)

Evaluation of tests – Internet Based Distance Learning – 2000 – (available to non-participants on request)

BROCHURE

A brochure for the general public is available. It is entitled "Hydropower – a Key to Prosperity in the Growing World", and can be found on the Internet (www.usbr.gov/power/data/data.htm) or it can be obtained from the Secretary (address on the inside back cover).

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PREFACE

The International Energy Agency (IEA) is an autonomous body, established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD). The IEA carries out a comprehensive programme of energy co-operation among 24 of the OECD's 29 member countries. The basic aims of the IEA, which are stated in the *Agreement on an International Energy Programme*, are the following:

- Co-operation among IEA participating countries to reduce excessive dependence on oil through energy conservation, development of alternative energy sources, and energy research and development
- An information system on the international oil market as well as consultation with oil companies
- Co-operation with oil producing and oil consuming countries with a view to supporting stable international energy trade, as well as the rational management and use of world energy resources in the interest of all countries
- A plan to prepare participating countries against the risk of a major disruption of oil supplies and to share available oil in case of an emergency.

At its inception, the IEA concentrated on issues related to oil. Since that time the Agency has broadened its work to include all forms of energy. More than forty «Implementing Agreements» have been set up to deal with specific energy technology issues. Such Agreements comprise a number of task forces, called "Annexes", which implement specific activities such as collection of data or statistics, assessment of environmental impacts, joint development of technology etc. The work of these Annexes is directed by an «Executive Committee» consisting of representatives of the participating Governments.

In 1995, seven IEA member countries agreed to co-operate in a five-year research program focused on hydroelectric power formally called the *Implementing Agreement for Hydropower Technologies and Programmes*. Italy withdrew, but France, United Kingdom and People's Republic of China subsequently joined the remaining countries. This Agreement proposed that four distinct Task Forces ("Annexes") should be set up to address the following topics:

Annex I:	Upgrading of Existing Hydropower Facilities
Annex II:	Small-Scale Hydropower
Annex III:	Hydropower and the Environment
Annex V:	Education and Training

Annex III "Hydropower and the Environment" entered into force in February 1995 with the following principal objectives:

- To arrive at a set of international recommendations for environmental impact assessment of hydropower projects, and criteria for the application of mitigation measures
- To improve the understanding of hydropower's environmental advantages and suggest ways to ameliorate its environmental drawbacks

- To forward national experiences regarding environmental effects of hydropower development at a project level and the legislation and decision making process at a national level
- To provide an environmental comparison between hydropower and other sources for electricity production

To achieve these goals the following Subtasks have been implemented:

Subtask 1: Survey of the environmental and social impacts and the effectiveness of mitigation measures in hydropower development *(Subtask leader: NVE, Norway)*

Subtask 2: Data base (included in Subtask 1)

Subtask 3: Environmental comparison between hydropower and other energy sources for electricity generation *(Subtask leader: Vattenfall, Sweden)*

Subtask 4: Survey of existing guidelines, legislative framework and standard procedures for environmental impact assessment related to hydropower development *(Subtask leader: UNESA, Spain)*

Subtask 5 Present context and guidelines for future action *(Subtask leader: Hydro-Québec, Canada)*

Subtask 6 Effectiveness of mitigation measures *(Subtask leader: Hydro-Québec, Canada)*

From a scientific perspective, environmental studies are complex because of the many interactions in the ecosystem. In a subject area as wide as hydropower and the environment, it has been important to maintain the scope of the work within the limits imposed by the five-year time schedule and the available financial and human resources. However, several of the topics discussed are very extensive and complex, and as such, ought to have been handled with resources equivalent to an Annex. The main Annex III challenges have been to define the context and focus on the most important environmental and social issues. Two guiding themes have been the relation to government decision-making processes, and the need to ensure the highest possible level of credibility of the work.

Annex III is based on a case study approach combined with experience from a wide range of international experts representing private companies, governmental institutions, universities, research institutions, and international organizations with relevance to the subject. In all 112 experts from 16 countries, the World Bank (WB) and the World Commission of Dams (WCD) have participated in meetings and workshops. Additionally, 29 professional papers have been presented at the meetings. The participating countries are responsible for the quality control of the information given at the national level. Reference groups have been consulted in some countries.

Like all extraction of natural resources, the harnessing of rivers affects the natural and social environment. Some of the impacts may be regarded as positive; others are negative and severe. Some impacts are immediate, whereas others are lingering, perhaps appearing after several years. The important question, however, is the severity of the negative impacts and how these can be reduced or mitigated. The aspect of ecological succession is also of great interest. Through history, the ecosystems have changed, as a result of sudden disasters or more gradual adjustments to the prevailing weather conditions. Any change in the physico-chemical conditions seems to trigger

processes that establish a new ecological equilibrium that matches the new ambient situation. Under natural conditions environmental change is probably more common than constancy. Ecological winners and losers, therefore, are found in natural systems as well as those created by man.

Even if the "fuel" of a hydropower project is water and as such renewable, the projects are often quite controversial since the construction and operation directly influences the river systems, whereby the adverse impacts become direct and visible. The benefits, like avoidance of polluting emissions that would have been the unavoidable outcome of other electricity generating options is, however, less easily observed.

Access to water and water resources management will be a very important environmental and social global challenge in the new century, because water is unevenly distributed and there are regional deficits. Dam construction and transfer of rivers and water abstraction are elements in most water management systems. The lessons learned from past hydropower projects may be of great value in future water resources management systems. If a regional water resources master plan or management system is available, then the development of hydropower resources could also contribute to an improved water supply for other uses.

It is necessary to underline that the Annex III reports discuss the role and effects of hydropower projects and how to improve their sustainability. They do not consider the increased energy consumption *per se* since this aspect is a national and political issue. Annex III has developed a set of international recommendations and guidelines for improving environmental practices in existing and future hydropower projects. One main conclusion is the necessity of an environmental impact assessment undertaken by competent experts and forming an integrated part of the project planning.

The Annex III reports have been accomplished based on a cost and task sharing principle. The total costs amount to USD 805 305, while the task sharing part had a budget of 93 man months. The reports which have been completed include 4 Technical reports (Subtasks 1, 3, 4, 6) with Appendices, one Synthesis report (Subtask 5) with Appendices and one Summary report presenting the recommendations and guidelines.

Annex III comprises the following countries and organizations: Canada (Ontario Hydro, 1995-98, Hydro-Québec 1995-2000), Finland (Kemijoki OY 1996-2000); Italy (ENEL 1995-98); Japan (CRIEPI 1995-2000); Norway (NVE 1995-2000); Spain (UNESA 1995-2000) and Sweden (Vattenfall AB 1995-2000).

ACKNOWLEDGEMENTS

I wish to thank the Annex III team, their companies and experts for the support and constructive and professional participation during all these 5 years. The Expert Meetings and Workshops have been characterized by an open, friendly and informal atmosphere, which have ensured common understanding with regard to professional content and the decisions made. During the 11 meetings the work has progressed steadily, with no steps back caused by misunderstandings or unclear decisions. Special thanks go to the National Representatives, Subtask Leaders and the Annex III Secretary for their enthusiasm, co-operation and achievement. On behalf of all the participants in our meetings and workshops, I would like to express our appreciation to the companies which were our hosts: Vattenfall, ENEL, UNESA, CRIEPI, NEF, Kemijoki OY and Hydro-Québec.

The credibility of the Annex III work has been greatly enhanced by the contributions from the participating experts representing: Ethiopia, Indonesia, Laos, Nepal, Philippines and Vietnam. Japan and Norway supported their participation. All Annex III countries and companies are thanked for financing additional internationally renowned experts in specialized subject areas. This ensured that progress was maintained and credibility was enhanced.

I also wish to thank the professionals who have filled in the comprehensive questionnaires. The participation from the World Bank and WCD has inspired the Annex III team and contributed to the actuality of our results.

The Executive Committee members are thanked for their guidance, support and co-operation.

Even if all names are given in the review of the IEA-Annex III Organization below, I would like to draw special attention to the following persons due to their active participation and support over the years: Mr. Jens Petter Taasen (Annex III secretary and STL 1), Ms. Kirsti Hind Fagerlund (Annex III secretary and STL 1), Mr.Björn Svensson (STL 3), Mr. José M. del Corral Beltrán (STL 4), Ms. Cristina Rivero (STL 4), Mr. Jean-Étienne Klimpt (STL 5), Mr. Gaétan Hayeur (STL 6), Mr. Serge Trussart (STL 6), Mr. Joseph Milewski, Mr. Frans Koch (Executive Committee secretary), Mr. Luc Gagnon, Mr. Raimo Kaikkonen, Mr. Hannu Puranen, Mr. Mario Tomasino, Mr. Shuichi Aki, Mr. Jun Hashimoto, Mr. Tsuyoshi Nakahata, Mr. Kiyoaki Uchikawa, Mr. Yohji Uchiyama, Mr. Svein T. Båtvik, Mr. Rune Flatby, Mr. Geir Y. Hermansen, Mr. David Corregidor Sanz ,and Mr. Magnus Brandel.

Oslo 30 March 2000

Sverre Husebye
Operating Agent
IEA-Annex III

IEA – Annex III Organisation

Operating Agent:

Husebye, Sverre	1995-2000	Norwegian Water Resources and Energy Directorate (NVE), Norway

Secretary:

Taasen, Jens Petter	1997-2000	Norwegian Water Resources and Energy Directorate (NVE), Norway
Fagerlund, Kirsti H.	1995-1997	Norwegian Water Resources and Energy Directorate (NVE), Norway

National representatives:

Hayeur, Gaëtan	1995-1997	Hydro Quebec, Canada
Klimpt, Jean-Etienne	1997-2000	Hydro Quebec, Canada
Kaikkonen, Raimo	1996-2000	Kemijoki Oy, Finland
Aki, Shuichi	1995-2000	Central Research Institute for Electric Power Industry (CRIEPI), Japan
Husebye, Sverre	1995-2000	Norwegian Water Resources and Energy Directorate (NVE), Norway
Corral, Jose del	1995-1998	Hidroelectrica Catalunia, Spain
Rivero, Cristina	1998-2000	UNESA, Spain
Svensson, Björn	1995-2000	Vattenfall Hydropower AB, Sweden
Tomasino, Mario	1995-1998	ENEL, Italy
Young, Christopher	1995-1997	Ontario Hydro, Canada

Subtask leaders:

ST1 Survey of the Environmental and Social Impacts and the Effectiveness of Mitigation Measures in Hydropower Development

Taasen, Jens Petter	1997-2000	Norway
Fagerlund, Kirsti H.	1995-1997	Norway

ST2 Creation of an International Information Data Base Comprising Environmental and Social Impacts, the Effect of Mitigation Measures and the Licensing Procedures Related to World Wide Experience of Hydropower Development
(Closed down in 1997, database included in ST1)

Young, Christopher	1995-1997	Canada
Yu, Margaret S.	1997	Canada

ST3 Environmental and Health Impacts of Electricity Generation

Svensson, Björn	Sweden

ST4 Survey of Exisitng Guidelines, Legislative framework and Standard Procedures for EA of Hydropower Projects

Rivero, Cristina	Spain
Corral, Jose del	Spain

ST5 Hydropower and the Environment: Present Context and Guidelines for Future Action

Klimpt, Jean-Etienne	Canada

ST6 Hydropower and the Environment: Efficiency of Mitigating Mesures

Trussart, Serge	Canada

Activity list Annex III:

Expert meetings and workshops

March 1995 - Montreal, Canada: : **18 participants**

October 1995 - Rome, Italy: **18 participants**

Case-study presentations

February 1996 - Stockholm , Sweden: **16 participants**

October 1996 - Madrid, Spain: **19 participants**

Presentations

Review of the national/provincial legislation in:

Canada	Young, Christopher	Ontario Hydro
Finland	Kaikkonen, Raimo	Kemijoki Oy
Italy	Tomasino, Mario	ENEL
Japan	Aki, Shuichi	Central Research Institute for Electric Power Industry
Nepal	Sudesh, Kumar Malla	Energy Development Centre
Norway	Flatby, Rune	Norwegian Water Resources and Energy Directorate
Spain	Rivero, Cristina	UNESA
Sweden	Svennson, Björn	Vattenfall Hydropower AB

General papers:

Kjørven, Olav, World Bank :Environmental Assessment at the World Bank: Requirements, Experience and Future Directions
Haagensen, Kjell, Statkraft: IEA program: Hydro Power and the Environment

April 1997 - Tokyo, Japan: **21 participants**

Presentations

Sumitro, Sasmito, Indonesia: The Saguling Hydro Power Electric and Environment Aspects
Manolom, Somboune, Laos: Hydropower and the Environment Lao PDR
Benito, Francisco A., Phillipines: Hydropower Development and the Environmental Impact System in the Philippines
Xayen, Nguyen, K. X., Vietnam: Brief Review on Hydropwer situations in Vietnam

October 1997 - Venice, Italy: **21 participants**

March 1998 - Rovaniemi, Finland: **20 participants**

October 1998 - Manila, Philippines: **28 participants**

Presentations

Merdeka, Sebayang, Indonesia: Environmetnal Aspects on Hydropower Development in Indonesia
Boungnong, Chanchaveng, Laos PDR: Socio-Environmental Impact Assessment of the Nam Ngiep 1Hydroelectric Project
Marasigan, Mario C., Philippines: Status of Mini-Hydropower Development in the Phillippines
Delizo, Tito D., Philippines: Tapping Private Sector for Small and Medium hydroelectricpower Plants in the Phillipines

March 1999 - Madrid, Spain: **25 participants**
November 1999 - Paris, France: **19 participants**

Technical Seminar

Escorial- Madrid, Spain 15-17 March 1999 **55 participants**

Presentations

Gagnon, Luc & Bélanger, Camille, Canada: Windpower: More Renewable than Hydropower?
Goddland, Robert, World Bank: What Factors Indicate the Future Role of Hydro in the Power Sector Mix? Environmental Sustainability in hydroprojects.
Henderson, Judy, South Africa: WCD-Strategy and Objectives
Husebye, Sverre, Norway: Status and Progress of the IEA-Annex III Work
Marasigan, Mario C., Philippines: Philippine Perspective: Hydropower and Rural Electrification
Nakamura, Shunroko, Japan: Recent River Ecosystem Conservation Efforts Downstream of Power Dams in a Densely Populated and Highly Industrialized Country: Japan
Oud, Engelebert, Germany: Planning of Hydro Projects

Roy, Louise, Canada: Ethical Issues and Dilemmas
Svensson, Björn, Sweden: A Life Cycle Perspective on Hydroelectric and Other Power Plants
Uchiyama, Yohji, Japan:Life Cycle Assessment For Comparison of Different Power Generating Systems
Pineiro, S.J.L., Spain: El libro blanco del agua en España

Subtask Leader meetings

July 1998 - Montreal, Canada
September 1999 - Montreal, Canada

Participants at the Annex III Expert meetings, Workshops and Technical Seminar (1995-2000):

Canada	Adams, Ken	Manitoba Hydro
Canada	Baillard, Dominique	Hydro Quebec
Canada	Egré, Dominique	Hydro Québec
Canada	Gagnon, Luc	Hydro Québec
Canada	Guertin, Gaétan	Hydro Québec
Canada	Hayeur, Gaëtan	Hydro Québec
Canada	Howard, M. Charles D.D.	Charles Howard and Associates Ltd
Canada	Kingsley, Tony	Canadian Electrical Association
Canada	Klimpt, Jéan-Étienne	Hydro Québéc
Canada	Koch, Frans	IEA-Hydropower Agreement
Canada	Lee, Walter	Engineering & Technical Support
Canada	Messier, Danielle	Hydro Québec
Canada	Milewski, Joseph	Hydro Québéc
Canada	Oud, Engelbert	Lahmeyer
Canada	Roquet, Vincent	VR Associates Inc.
Canada	Rowsell, Jim	Ontario Hydro
Canada	Roy, Louise	Consensus Inc.
Canada	Trussart, Serge	Hydro Québéc
Canada	Young, Chris	Ontario Hydro
Canada	Yu, Margaret S.	Ontario Hydro
Canada	Zbignewics, Halina	Manitoba Hydro
Ethiopia	Gunjo, Wakgari	Ministry of Mines and Energy
Ethiopia	Shenkut, Gebresemayat	Ministry of Mines and Energy
Finland	Aula, Antti	Kemijoki Oy
Finland	Huttunen, Arja	Arctic Centre (Rovaniemi)
Finland	Hyvönen, Matti	Lapland Regional Environment Centre
Finland	Kaikkonen, Raimo	Kemijoki Oy
Finland	Nuutinen, Jaana	Kemijoki Oy
Finland	Puranen, Hannu	Kemijoki Oy
Finland	Soimakallio, Helena	FINERGY
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Indonesia	Sebayang, Merdeka	Department Pertambangan Dan Energi R.I., Direktorat Jenderal Listrik Dan Pengembangan Energi
Italy	Linari, Antonio	ENEL
Italy	Moretti, Alessandro	ENEL
Italy	Saccardo, Italo	ENEL
Italy	Tomasino, Mario	ENEL
Italy	Valle, Francesco Dalla	ENEL
Japan	Aki, Shuichi	Central Research Institute for Electric Power Industry (CRIEPI)
Japan	Baba, K.	JANCOLD
Japan	Hashimoto, Jun	Electric Power Development Co.
Japan	Kanno, Shigeru	NEF
Japan	Maeda, Yumiko	KDC Ltd.
Japan	Miyanaga, Yoichi	Central Research Institute for Electric Power Industry (CRIEPI)
Japan	Murakami, Shoichi	Chiba Institute of Technology, Electric Power Development Company Ltd.

Japan	Nakahata, Tsuyoshi	Ministry of International Trade & Industry (MITI)
Japan	Nakamura, Shunroku	Toyohashi University of Technology (TUT)
Japan	Nishiwaki, Yoshifumi	Tokyo Electric Power Co.
Japan	Ohkawara, Toru	Central Research Institute of Electric Power Industry (CRIEPI)
Japan	Onoyama, Kiichiro	Electric Power Development Co. Ltd.
Japan	Sannomiya, Chika	KDC Engineering Co. Ltd.
Japan	Takano, Jun	Hokkaido Electric Power Co., Inc.
Japan	Tanaka, Susumu	NEF
Japan	Uchikawa, Kiyoaki	NEF
Japan	Uchiyama, Yohij	Central Research Institute for Electric Power Industry (CRIEPI)
Laos PDR	Boungnong, Chansaveng	Ministry of Industry-Handicraft, Department of Electricity, Hydropower Office
Laos PDR	Manolom, Somboune	Ministry of Industry-Handicraft, Department of Electricity, Hydropower Office
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Norway	Bjørnå, Kjell O.	Norwegian water resources and energy directorate
Norway	Brittain, John	Norwegian water resources and energy directorate
Norway	Båtvik, Svein T.	Directorate of Nature Management
Norway	Erlandsen, Arne	Norwegian Electricity Association (ENFO)
Norway	Fagerlund, Kirsti	Norwegian Water Resources and Energy Directorate
Norway	Faugli, Per E.	Norwegian Water Resources and Energy Directorate
Norway	Flatby, Rune	Norwegian Water Resources and Energy Directorate
Norway	Hermansen, Geir	Ministry of Oil and Energy (OED)
Norway	Hesselberg, Jan	University of Oslo, Insitute of Soscial Geography
Norway	Husebye, Sverre	Norwegian Water Resources and Energy Directorate
Norway	Haagensen, Kjell	Statkraft
Norway	Riise, Ulf	Norwegian Electricity Association
Norway	Torblaa, Eivind	Norwegian Electricity Association
Norway	Taasen, Jens P.	Norwegian Water Resources and Energy Directorate
Norway	Østhagen, Håvard	Norwegian Water Resources and Energy Directorate
Norway	Øvstedal, Jarle	Norwegian Water Resources and Energy Directorate
Philippines	Benito, Francisco A.	Department of Energy (DOE)
Philippines	Cabazor, Ramon D.	Department of Energy
Philippines	Delizo, Tito D.	National Power Corporation
Philippines	Marasigan, Mario, C.	Department of Energy
Philippines	Morante, Jennifer L.	Department of Energy
Philippines	Rayos, Alex H.	Department of Energy
Philippines	Salvania, Rey V.	Department of Energy
Philippines	Sargento, Ronnie, N.	Department of Energy
Philippines	Zabala, Arnulfo M.	Department of Energy
Spain	Alonso, Miguel	Limnos
Spain	Alvaro, Jose A.	Iberdrola
Spain	Bailly-Bailliere, Enrique	Ministerio de Medio Ambiente
Spain	Borrego, Margarita	UNESA
Spain	Corregidor, David	UNESA
Spain	Cortés, Hernán	ENDESA
Spain	Del Corral, J. Miguel	Hidroélectrica de Cataluna-1, S.A.
Spain	Diaz Pineda, Francisco	University Complutense of Madrid
Spain	Lopez Marinez, Javier	Minstry of Industry and Energy
Spain	Palau, Antonio	University of Lérida
Spain	Piñeiro, Santiago J.L.	Ministerio de Medio Ambiente
Spain	Plaza, Vicente	UNESA
Spain	Rivero, Cristina	UNESA
Spain	Sabater, Juan	ENDESA
Sweden	Brandel, Magnus	Svenska Kraftverksföreningen
Sweden	Brink, Björn	Svenska Kommunforbundet
Sweden	Leckström, Rogert	Svenska Kommunforbundet
Sweden	Malmkvist, Maria	Swedish National Energy Administration
Sweden	Stahl, Carl-Ivar	Swedish National Energy Administration
Sweden	Svensson, Björn	Vattenfall Hydropower AB
UK	Taylor, Richard M.	International Hydropower Association
USA	Galbreth, Tim	Tennessee Valley Authority
USA	Sullivan, Charles	Electric Power Research Institute, California
Vietnam	Xayen, Nguyen Kim	Technology, Environment and Computer Center - Electricity of Vietnam

Goodland, Robert	World Bank
Kjørven, Olav	World Bank
Ziegler, Tor	World Bank
Henderson, Judy	World Commission on Dams
Haas, Larry	World Commission on Dams
Skinner, Jamie	World Commission on Dams

SUBTASK 4 – ACKNOWLEDGEMENTS

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Finally I wish to thank Tor Ziegler from the World Bank and our colleagues from Nepal, Indonesia, Korea, Philippines, Taiwan, Tanzania, Thailand and from the legal group of UNIPEDE/EURELECTRIC, as well as the experts who participated in the Technical Seminar held in El Escorial, with particular mention to those contributing to the review of the preliminary report.

Madrid, 30 April 2000

Cristina Rivero
UNESA
IEA – Annex III, Subtask 4 Leader

SUMMARY

This report makes a survey and analyses the way in which the process of environmental impact assessment is implemented in different countries. It provides the basis to subtask V on the considerations to be made about the different existing guidelines, legislation and standards for the environmental impact assessments in the countries and regions surveyed. Different opinions are also gathered considering the applicability and efficiency of the process. The report is divided into four major sections.

The first section describes the scope and methodology used for the survey.

The second section analyses the different environmental assessment procedures, distinguishing between the policy level EIAs, where strategic, sectoral and regional environmental assessments and their present use are presented, and focusing mainly in project specific EIAs. For the latter, the different steps of the process are analysed, starting with the terminology used, the elements and aspects usually included in an EIA and reviewing in more detail the processes of screening, scoping, consultation, environmental studies and post decision monitoring. It also presents the typical issues included in an EIA for hydropower projects and the different types of hydroelectric projects subject to EIA in the different countries and regions surveyed.

The third section presents the views of the main findings from the questionnaire focusing in certain selected issues like time limits and public participation, the role of Government bodies, study carried out by an independent body, present use of plans and study of alternatives, assessment of cumulative impacts, mitigation and compensation measures and relicensing and upgrading.

The fourth section states the conclusions on the Applicability and Efficiency of the process, being these comments the opinion of the contributors to the questionnaires and of the National Experts of the Annex III as well as from the different experts contacted.

The main conclusions of this report are that

a) Concerning the EIAs, the following positive aspects reported in the questionnaires can be highlighted

   – The EIA process prevents and mitigates adverse impacts of development activities to attain the goal of environmental protection, leading to a gradual improvement of the environmental optimization of the projects and a stronger awareness of the promotors and the competent government bodies.

   – The experience and the accumulated knowledge in the course of time is of great value, helping in particular when refering to the application of mitigation measures to minimise the impacts.

   – There is a tendency of increasing participation of the public in the process, rising its transparency.

b) Nevertheless, there are ineffeciencies in the process that to some extent minimise the original objective of the EIA and make difficult its implementation, in many cases even hindering the development of new hydropower projects. In this sense after the incorporation of the EIAs, the authorisation procedures for hydropower plants, being *per se* very slow have resulted in even more time consuming, processes requiring and average time of 5 to 12 years in some countries between the notice of intention and the authorisation to begin building.

c) Another bottleneck in the process is the lack of co-ordination between the different authorities involved at national, federal, regional and/or local level. Hydroelectric power plants are subject to a sophisticated legal framework for both their development and their operation. Overall, approval mechanisms are cumbersome and complex, involving usually several different parties, thus causing serious problems for proponents. Ultimately, a project may be approved by one authority and rejected by another. This adds to the risks a proponent assumes. This lack of harmonisation among the different authorities involved in the process is identified in some cases as the real origin of a very inefficient process, often requiring additional data or the re-examination of the whole evidentiary record.

d) The existing guidelines for impact assessment studies often provide an exhaustive, even encyclopaedic list of every study that could possibly be conducted regarding a project. No effort seems to be made to focus onto the key issues, what remains a challenge for the responsible governmental body in many countries. There is a common agreement that the EIA should be a more focused process, starting with the more crucial problems and going down to minor problem and that the many studies completed over the years should help limit the subject of the studies proposed so that social and environmental acceptability can be decided by the key issues rather than by secondary concerns posing little environmental risk. However, this problem seems to be solved to some extent in certain cases with a requirement that applicants consult in advance of the preparation of any license application, with state and federal resource agencies regarding the impacts of a project and the kind of studies which should be done to investigate those impacts.

e) Despite all the studies and efforts made, there is an existing trend of denying the approval of the construction of new hydropower plants due to a growing awareness of the environment which is becoming more widespread, causing a standstill in hydropower development in some countries.

f) Another weaknesses in the EIA process refer to the monitoring and surveillance programmes due to the lack of awareness of the cost of implementing them, a lack of control or a lack of funding as well as the low public participation in the process, the lack of enough qualified and multidisciplinary teams of experts in some countries, the scarce resources available for the studies, the consideration of the process as a mere administrative step and the absence in many cases of a serious alternatives study.

1. INTRODUCTION

Since the USA incorporated in 1969 in its National Environmental Policy Act (NEPA) the requirement of assessing the environmental effect of "major federal actions significantly affecting the quality of the human environment", the concept and practice of environmental impact assessment has spread through many countries that have developed different guides, rules or legislation on the issue.

The importance and usefulness of the Environmental Impact Assessments as a tool for helping decision-making processes in development planning is widely acknowledged. In this sense, Principle 17 of the Rio Declaration on Environment and Development reads:

"Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority."

However it is also well known that the process has become in many cases an institutional practice and is constraint by certain defaults.

This report intends to analyse the way in which the process of environmental impact assessment is implemented in different countries, mentioning also the growing use of other environmental tools such as the Strategic Environmental Assessments. It also presents the different environmental issues covered by different countries with a different legal framework with reference to the EIA process, and focuses on comments on the applicability and efficiency of the process.
For the common understanding, it is necessary to specify that when talking about EIA it is referred to project specific environmental impact assessments.

1.1 Objective/Purpose

The objective of subtask IV, and therefore of this report is to provide the basis to subtask V on the considerations to be made about the different existing guidelines, legislation and standards for the environmental impact assessments in the countries and regions surveyed. Different opinions are also gathered considering the applicability and efficiency of the process in those countries and regions and driven from conclusions of other international studies.

1.2 Sources and method

In order to collect the necessary information in a homogeneous manner, a brief questionnaire was designed and sent worldwide. The questionnaire intends to reflect the situation concerning hydropower development in each region surveyed focusing on the legislative framework and implementation of the Environmental Impact Assessment procedures.

The questionnaire, presented in Annex I, is divided in seven parts. The first part, "General description of the water system and the hydropower development in the country", intends to collect information on general hydrological features and on the electricity production, giving the context of the hydropower development in the country. It includes the description of regulations or plans for the use of water resources for hydroelectric development, as well as the main environmental aspects related to hydropower development in the country.

The second set of questions, "Legislative framework concerning hydropower development and environmental issues" intends to collect the legislative structure concerning the use of water resources, the hydropower development and the EIA.

In the third and fourth parts, "EIA Procedures and process", a description of the whole EIA process is required concerning administrative and licensing aspects such as timing, authorities involved and different steps of the administrative process. Information is collected on project specific environmental impact assessments. The difference between procedure and process, in this context, is that in the term procedure we include the administrative requirements and with the term process we are referring to the process of assessing the effects of a project on the environment, avoiding the administrative nature of them.

Concerning the EIA Process, information on the different phases, time requirements and especially public involvement is collected. The EIA process has been divided in three parts: Initial, Application and Operational phase.

The fifth part, "General comments on the applicability and/or efficiency of the process" refers to general ideas on the applicability and efficiency of the different processes. Though the degree of subjectivity observing this question can lie in a very large frame, the conclusions to be obtained are to be understood as an approximation to the general feeling, and not as a concluding issues.

The sixth part, "Description of the main environmental issues included in the EIA studies" collects specific information on environmental issues, mitigation measures, surveillance and monitoring programmes.

The last part refers to "Relicensing and upgrading", dealing with the situations in which and EIA is required not for the construction of a project but for the relicensing and/or upgrading of existing installations, in order to evaluate differences in the EIA processes and convenience of using that tool for such particular cases.

1.3 Contributions to the questionnaire

Contributions have been received from the following countries and/or regions: Canada (Quebec), Finland, Nepal, Indonesia, Italy, Japan, Korea, Malaysia, Norway, Spain, Sweden, Taiwan, Tanzania, Thailand, USA (States of New York, Maine and Vermont), and from the Legal group of UNIPEDE/EURELECTRIC, as well as from the World Bank

1.4 Outline/Overview of the report

The report focuses mainly on project specific environmental impact assessments, presenting the main findings from the questionnaire and analyses also conclusions taken from other international review studies, describing as well other related environmental tools such as the strategic, regional and sectoral environmental assessments. It is structured in four main chapters. Chapter 1 presents the introduction, scope and method of the work done. Chapter 2 analyses the different environmental assessment procedures, distinguishing between the policy level EIAs, where strategic, sectoral and regional environmental assessments and their present use are presented, and focuses mainly in project specific EIAs. For the latter, the different steps of the process are analysed, starting with the terminology used, the elements and aspects usually included in an EIA and reviewing in more detail the processes of screening, scoping, consultation, environmental studies and post decision monitoring. It also presents the typical issues included in an EIA for hydropower projects and the different types of hydroelectric projects subject to EIA in the different countries and regions surveyed.

The chapter three presents the main findings from the questionnaire focusing in certain selected issues: Time limits and Public participation, The role of Government bodies, Study carried out by an independent body, Present use of plans and Study of alternatives, Assessment of cumulative impacts, Mitigation and compensation measures and Relicensing and upgrading. The chapter four ends with the comments made on the Applicability and Efficiency of the process in the questionnaires, being these comments the opinion of the contributors to the questionnaires and of the National Experts of the Annex III.

2. THE EIA PROCESS IN DECISION-MAKING

EIA was first formally established in the USA in 1969 through the requirement incorporated in its National Environmental Protection Act of assessing the environmental effect of "major federal actions significantly affecting the quality of the human environment", and has since then spread in various forms, to most countries([1]). A 1985 European Community Directive on EIA (Directive

([1]) Based on Glasson et. al Introduction to Environmental Impact Assessment, principles and procedures, process, practice and prospects, UCL Press 1996.

85/337) introduced broadly uniform requirements for EIA to all EC Member states. At present several years after the 1988 implementation of the EC Directive, Member States are carrying out EIA in a variety of forms, and discrepancies in implementation are becoming obvious. The nature of EIA systems - e.g. mandatory or discreationary, level of public participation types of actings requiring EIA - and their implementation in practice vary videly from country to country. However, the rapid spread of the concept of EIA, and its central role in many countries' programmes of environmental protection, attest to it´s universal validity as a proactive planning tool.

The US National Environmental Policy Act of 1969, also known as NEPA, was the first legislation to require EIAs to be carried out. Consequently it has become an important model for other EIA systems, both because it was a radically new form of environmental policy, and in the successes and failures of its subsequent development. Since it´s enactment, NEPA has resulted in the preparation of well over 15 000 EIAs, which have influenced countless decisions and represent a powerful base of environmental information. On the other hand, NEPA is unique. Other countries have shied away from the form i takes and the procedures it sets out, not least because the are unwilling to face a situation like that in the USA, where there has been extensive litigation over the interpretation and workings of the EIA system.

2.1. Policy level EIAs

Generally speaking, the Environmental Impact Assessments refers to the project-specific level, in which a procedure is established to determine the environmental impact of a specific project as well as the possible alternatives to mitigate or compensate the negative effects. Nevertheless, other environmental tools have been developed in a much wider framework in order to determine and help at the decision making level in the determination of a whole of environmental aspects of programmes, plans, regional development, etc. Those processes are then called strategic EIA, sectoral EIA, and regional EIA depending on the scope of the process.

Sectoral Environmental Assessments for example, are used in the World Bank for the design of sector investment programs. As defined in the Operational Directive for Environmental Assessment[2], " *They are particularly suitable for reviewing (a) sector investment alternatives; (b) the effect of sector policy changes; (c) institutional capacities and requirements for environmental review, implementation and monitoring at the sectoral level; and (d) the cumulative impacts of many relatively small, similar investments that do not merit individual project-specific EAs. Sectoral EAs should also have the objective of strengthening the environmental management capability of the sectoral or other relevant agencies. "*

Therefore, sectoral EAs are a more efficient tool than project-specific EAs in addressing sector-wide environmental issues, including alternative investment strategies, and in bringing them to the attention of decision-makers. They are specially used in the energy, water and agriculture sectors.

[2] The World Bank Operational Manual. Operational Directive 4.01: Environmental Assessment. October 1991.

Regional Environmental Assessments are a less common practice than sectoral and especially than strategic EAs. As defined in the Operational Directive of the World Bank: *"Regional EAs may be used where a number of similar but significant development activities with potentially cumulative impacts are planned for a reasonably localised area. In such cases, regional EAs are generally more efficient than a series of project-specific EAs. They may identify issues that the latter might overlook (e.g. interaction among effluents or competition for natural resources). Regional EAs compare alternative development scenarios and recommend environmentally sustainable development and land use patterns and policies. Impacts may sometimes extend across national boundaries. However, regional EAs with an institutional focus might follow administrative boundaries. Regional EAs are particularly useful when they precede the first in a series of projects or development interventions in an underdeveloped region, where a region is slated for major developments, where cumulative impacts are anticipated, or in regional planning or agro-ecological zoning."*

Regional EAs are especially useful when planned development risk to cause cumulative or interrelated effects on the environment of a region. This is the case of a chain of hydroelectric power plants planned in a basin. REAs are also called **Regional Environmental Plans**. They provide a local framework then can avoid much of the work done at the project specific EIAs.

When the environmental assessment applies to policies, plans and/or programmes, it is called **Strategic Environmental assessment** (SEA). SEAs provide the general framework in which individual EIA for specific projects are to be developed. They deal with more general issues like sustainability, cumulative effects, management and conservation of resources, global trends concerning environmental goals, commitments, etc., while project-specific EIAs can only deal with local effects. In this way, SEA helps to refocus and streamline EIA processes, avoiding some of its important limitations.

Furthermore, some important environmental impacts occur at global, continental, national or regional scale, making impossible to evaluate them in a project specific basis. Issues like climate warming, acidification, loss of biodiversity, etc. can only be properly addressed in the framework of SEA. The same is true concerning cumulative effects resulting both from the addition and interaction of multiple factors.

These basis are widely recognised, and established for example, in the Convention on Biological Diversity, where a clear distinction is made between EIA and SEA in article 4, as follows:

" Each contracting Party, as far as possible and appropriate, shall:

a) Introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimising such effects and, where appropriate, allow for public participation in such procedures.

b) Introduce appropriate arrangements to ensure that the environmental consequences of its

programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account."

The concept of SEA appears also in the text of the United Nations Framework Convention on Climate Change, in its article 4:

"All parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances shall:

...f) Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessment, formulated and determined nationally, with a view to minimising adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken to them to mitigate or adapt to climate change."

As can be seen, SEA provides an integrated approach to decision making, especially for governmental policies that lie in the base of development. It helps therefore to integrate environmental considerations and objectives into wider decisions.

In terms of practical application, SEA involves methods used both in project EIA and in policy analysis processes, like matrices, GIS, scenarios, cost benefit analysis. It is a growing practice and a very rapid emerging field of work, as can be seen from the increasing number of conferences, research projects, scientific articles, courses, etc... referred to it, but it is still a more recent and less developed practice than project EIA.

In an International study on Strategic Environmental Assessments[3], three major benefits of SEA were identified:

1. Strengthening project-level EIA
2. Addressing cumulative and large scale effects
3. Incorporating sustainability considerations into the "inner circles" of decision making.

Concerning the regulatory framework for SEAs, it is generally a very recent one, but many countries are developing regulations and carrying out such initiatives. The types of SEA provisions fall generally in one of the following three categories:

Legislation; which establishes a mandatory requirement
Administrative order; quasi mandatory
Advisory guidelines or operational policy; in principle non mandatory

[3] Strategic Environmental Assessment. Status, Challenges and Future Directions.
Ministry of Housing, Spatial Planning and the Environment of The Netherlands.
International Study of Effectiveness of Environmental Assessment.
The EIA-Commission of The Netherlands.1996

These distinctions are very important, as they may provide or not rigorous basis for the application of SEA.

The European Union for instance has emitted a Proposal[4] for a Directive on the assessment of the effects of certain plans and programmes on the environment with the aim of providing a higher level of environmental protection, providing the framework for subsequent development consents. The EU understands that SEA will contribute to a more transparent planning and to the goal of sustainable development.

In a study carried out by the EU on the implementation of 20 Strategic Environmental Assessment initiatives[5], the following benefits of such a tool were identified:

- Provides a systematic review of relevant environmental issues
- Improves and refines the basic strategic concepts involved in the policy, plan or programme
- Achieves a clearer understanding of the potential environmental effects
- Enhances the policy, plan or programme's contribution to the overall goals of environmental sustainability
- Creates a better balance between environmental, social and economic factors (thus aiding the decision-making process)
- Simplifies the process of environmental investigations at the individual project level, and thereby reduces or possibly avoids the need for Project EIA while also accelerates the process of decision making
- Enhances the transparency of the plan making process, and wins public support for preferred options or strategies
- Provides guidance on the development of mitigation proposals
- Helps to define environmental target for monitoring purposes

The main conclusion point out that SEA is already in widespread use throughout the European Community, and that many forms of assessment fall within the definition of SEA. It is a relevant process at all levels of public decision making which precede the project level. It overlaps many times with the project EIA, particularly in relationship with infrastructure projects. It is clear from the case studies of the EIA projects analysed that some of the environmental constraints could have been avoided if alternative routes and alignments had been considered at the policy formulation stage. The main conclusions reached by the European Commission in the review of SEA case studies[6] are the following:

- SEA is becoming well established in sectors such as land-use planning, energy, waste management and transport. SEA application in the sectors of water management, industry, agriculture and tourism is still very rare.

[4] SEA Proposal (COM(96)511 Final). Amended in February 1999

[5] "EIA/SEA in Europe: a study on costs and benefits

[6] European Commission: Case Studies on Strategic Environmental Assessment. February 1997.

- The link of SEA to the planning process requires an in-depth analysis of the decision making process. For specific countries and sectors case studies should be undertaken.

- SEA is more effective and efficient in cases where an environmental policy or sustainability strategy exists.

- Scoping should ensure that the SEA focuses on key issues. It requires early consultation and public participation. It should be externally reviewed and documented.

- Even though the assessment of alternatives is often quoted as one of the basic requirements, in practice this is not always proving. For land-use plan it is recommended that alternative option should be identified and assessed at certain stages.

- Uncertainties in impact predictions and evaluations should be acknowledged, analysed and reported.

- Certain prediction and evaluation methods can be applied internationally (waste management plans, transport corridor assessment, land-use planning). For these specific categories, the development of EU "best practice" guidelines is worth consideration.

- In respect to public participation specific methods should be developed to increase participation. Involvement of environmental action organisations (NGOs) should be encouraged.

- Effectiveness indicators should be established for the process.

- Time and costs of SEA will be gradually reduced by increased experience.

- Where the proponent and the competent authority were closely involved in the process, this contributed to an increased awareness in motivation.

2.2. Project specific EIAs

The term Environmental Impact Assessment, following the definition made in the EU Directive 85/337/EEC of 27 June 1985, applies to the identification, description, and assessment of the direct and indirect effects of a project on: human beings, fauna and flora; soil, water, air, climate and the landscape; the interaction of these factors; and on material assets, and the cultural heritage. This procedure ensures that the environmental effects of projects are identified and assessed before an authorisation is given and enables the public to give their opinion and to influence the process.

2.2.1. Terminology

It is very important to clarify the different terminology used in different countries applying to the same concept. Not only when defining the EIA process are there many divergences, but also when trying to give a definition for the terms environment, impact, etc… many different understandings arise. In this sense, and as a direct consequence of reviewing the international literature, various forms and expressions appear, concerning not only the meaning of terms but also to the scope of their application, which are essential to know and to bring up a better understanding. Moreover, and within this international context, these situations are very often responsible of misunderstandings and wrong interpretations of the same reality. In order to avoid some of these ambiguity in the future, a few of the most common terminology is below presented as follows:

- *Environmental Impact Assessment (EIA):* following the definition made in the EU Directive 85/337/EEC of 27 June 1985, applies to the identification, description, and assessment of the direct and indirect effects of a project on: human beings, fauna and flora; soil, water, air, climate and the landscape; the interaction of these factors; and on material assets, and the cultural heritage.

-. *Environmental Impact Statement (EIS):* is a document prepared by a developer applicant describing a proposed policy, program or project; alternatives to the proposal, and measures to be adopted to protect the environment. It is then a step into the EIA process. The document is then subject to an EIA. In some countries it is known as EIA report and/or Environmental Impact Study. In other countries the Environmental Impact Statement refers to the final resolution concerning the feasibility of the project coming from the environmental authority.

-. *Environmental Assessment Process (EA):* usually refers to the whole technical and administrative EIA process.

It is extremely important to reach a consensus in the terminology used at the international level. The harmonisation of the terms and the scope would be not only desirable, but also would support the continuos efforts and the increasing investments that are taking place in all over the world, specially in the developing countries.

2.2.2. Elements and aspects usually included in an EIA.

The following diagram covers what could be defined as a general EIA procedure according to the European Commission. The process includes at the main steps:

1. Project Preparation: pre-feasibility and detailed feasibility studies undertaken during the course of the initial project design.

2. Notification to Competent Authority

3. Screening to determine need for environmental impact assessment

4. Scoping: determining the key environmental issues associated with the proposed project or activity

5. Environmental Studies: Preparation and submission of environmental information to the competent authority

6. Consideration of environmental information

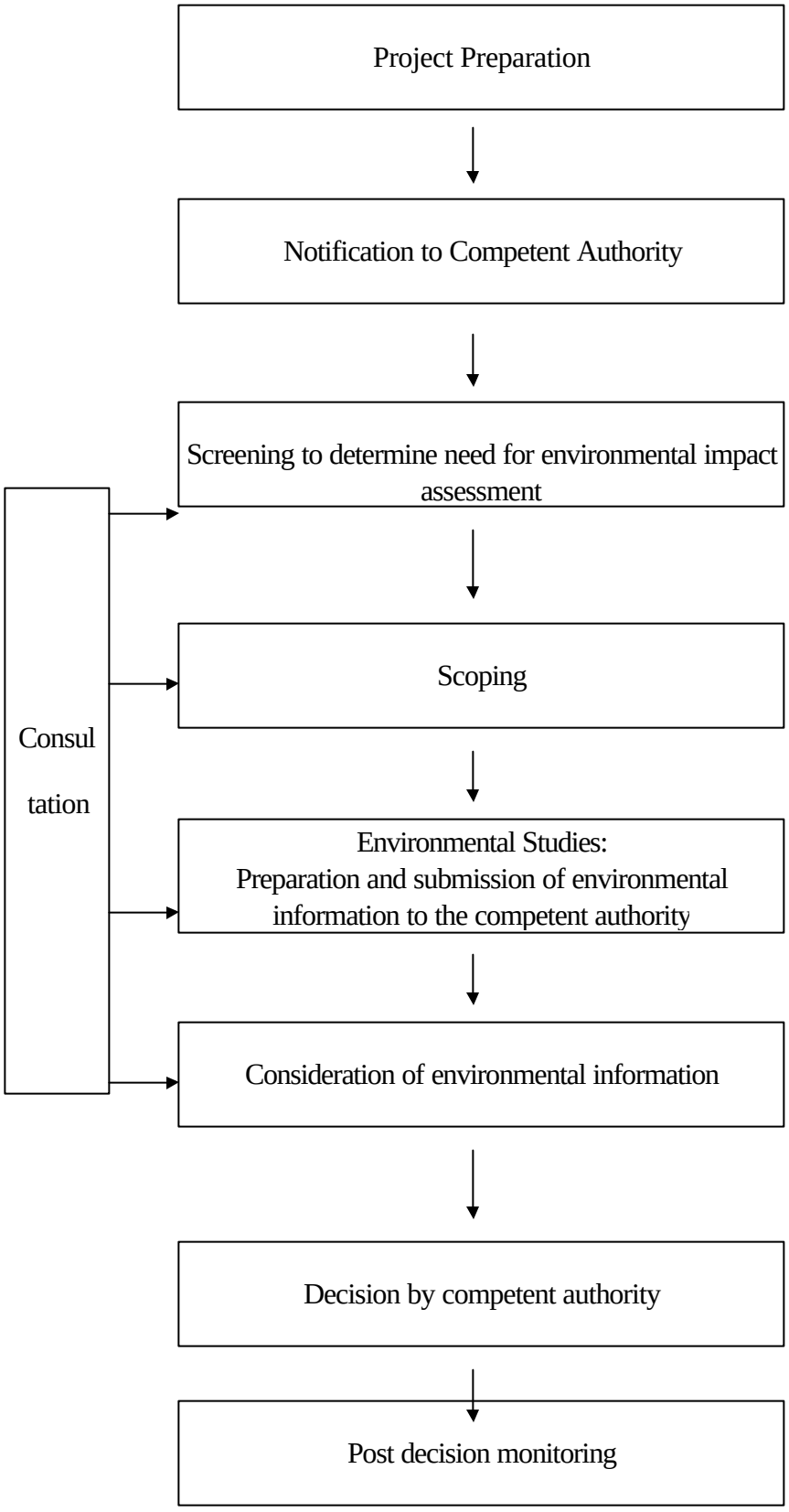
7. Decision by competent authority

8. Post decision monitoring also known as Post Project Analysis or PPA

Different steps for consultation are foreseen during the process.

Not all these stages are required by law, but the European Commission understands that in practice a comprehensive EIA process might be expected to include all these activities. The steps of the process concerning screening, scoping, consultation environmental studies and post decision monitoring are analysed more in detail later in the chapter.

The Environmental Impact Assessment Process[7]



[7] EIA: Guidance on Screening. European Commission, DGXI, May 1996.

I. Screening

The purpose of the screening process is to determine whether EIA is required for a particular project. Screening requires then a decision to be made on whether a project *"is likely to have significant effects on the environment by virtue,* inter alia*, of its nature, size or location*." in terms expressed in the EU Directive (article 2.). The European Commission, DGXI, issued in May 1996 a "Guidance on Screening", based on a review of screening procedures and practices in more than 30 regional, national and international EIA systems. In some Member States, screening is the first step in the EIA process, but in other, prior screening by a competent authority is not formally required or is voluntary.

It is important to make clear the difference between screening and scoping. Scoping is the process of deciding the issues to be investigated in the EIA, once the decision has been made that an EIA is required. There may be some overlaps nevertheless between the processes of scoping and screening. For example, the information to be used to make a screening decision can be subsequently used for scoping. In some countries, a preliminary environmental assessment is carried out, for the purpose of screening, using the results to determine whether a full or simplified EIA process has to be undertaken. These results can also be used to scope the full EIA. Sometimes the terminology is not clear for distinguishing between the preliminary assessment and the scoping study.

The guidance of DGXI suggests the following six steps to conduct the screening process:

"1. *To check whether the project in question is on a mandatory positive list at either national, regional or local level. The lists are typically defined in terms of size of project above which EIA is required. Information on the size of the project is therefore required in order to make a screening decision. The way in which size is expressed varies between project types but may be area, dimensions, throughput, production, number of units, cost or other measure*.

2. *To check whether the project is in a location for which EIA is mandatory under the terms of national, regional or local legislation.*

3. To consult any national or local guidance on project characteristics affecting the need for EIA. Organisations who may have prepared such guidance include national EIA authorities, other national environmental agencies, and local authorities. This type of guidance information will be needed on the size or other characteristics of the project.

4. If a screening decision cannot be made on the basis of mandatory of advisory lists, a fourth step may be to request information on the types detailed overleaf from the developer and examine this to assess the likelihood of significant impacts arising from the project.

5. To consider a Checklist of Screening Questions (provided in this guide, includes project related factors, location related factors, impact related factors and wider considerations) as an *aid to assessing the likelihood of significant impacts and other factors which might*

influence the decision to require an EIA.

6. *To record the conclusion and the reasons for it and to advise the developer and other required parties on whether EIA is required."*

II. Scoping

Many of the difficulties recognised world wide in elaborating the EIAs can be reduced, as concluded in many studies, by starting the process at an early stage, involving all the affected parties from this beginning and starting from the selection of significant issues to be analysed or assessed, warranting this way that the process focuses in what is really important and saving time, money and discussions. This process is defined as scoping.

In 1978 a NEPA regulation was introduced in the USA stating that: "there shall be an early and open process for determining the scope of the issues to be addressed and for identifying the significant issues relating to a proposed action. This process was to be called "scoping"".

However, and though the benefits of including the scoping into the EIA process may seem quite evident, there is not a fully acceptance in the regulatory framework of many countries. The Japanese legislation, for example, concerning EIA does not take into account the initial phase of the process up to now, though there is a new law to be enforced in summer 1999 that will include a process of screening and scoping.

The Directorate General XI of the EU, in its study "Evaluation of the Performance of the EIA process" issued in October 1996, concludes that "the Commission should consider ways of encouraging Member States to adopt formal scoping requirements", having found that the nature and extent of provision of scoping varies considerably between Member States.

To be more concise, in the study, a lack of scoping methodology was evidenced among member States, as well as an insufficient or inadequate definition of criteria or of systematic approaches to prioritise key issues. Also insufficient involvement of the public and of statutory consultees in scoping and lack of experience and trained personnel were the main findings of the survey.

The EU DGXI issued in 1996 a guidance on scoping, where the scoping is defined as the stage in Environmental Impact Assessment when decisions are made on the information to be submitted as part of the Environmental Impact Assessment process; it is then carried out once a decision has been made that EIA is required with the purpose of identifying the matters which should be covered in the environmental information to be submitted to the competent authority.

The scoping activities include, according to that guide:

1. Identification of potential impacts. According to the EU Directive, impacts on the following factors must be taken into account:

– Population
– Fauna and flora
– Soil
– Water
– Air and climatic factors
– Material assets, including architectural and archaeological heritage
– Landscape
– Inter-relationships between these factors

2. Review of alternatives, as indicated in the Directive, refers to "an outline of the main alternatives studied by the developer and an indication of the main reasons for this choice, taking into account the environmental effects"

3. Consultations

Meaning discussions with different organisations on the issues they would like to see in the EIA. This process of consultation during the scoping step is not mandatory in all the systems. The types or organisations that may be consulted are according to the EU Commission:

- The competent authority
- National, regional and local government organisations responsible for environmental protection, nature conservation, heritage, landscape protection, land use, spatial planning and pollution control
- Sectional government departments responsible for agriculture, energy, fisheries, forestry, etc. whose interests may be affected by the project
- Relevant international agencies
- Local authorities and elected representatives
- Local community representatives and residents, groups, perhaps including community figures such as religious leaders and teachers
- Landowners and local residents and businesses
- Local, national and international non-governmental organisations with interests in the environment
- Groups representing users of the environment
- Research institutes, universities and other centres of expertise
- Employers' and employees' organisations such as local chambers of commerce, industrial or trade associations, trade unions.

4. Deciding on the most significant impacts

5. Preparation, consultation, finalisation and ongoing review of the EIA scope

All the previous steps may be included in a report for internal use or publication (mandatory in some systems). The scope may also include the workplan for the EIA.

The following benefits are attributed to the scoping process in that guide:

- "It helps to ensure that the environmental information used for decision-making provides a comprehensive picture of all the effects of the project, including issues which are of particular concern to affected groups and other interested parties.

- At the same time, it helps ensure that attention is focused on the issues which are of most importance for decision-making, avoiding collection of unnecessary information and unproductive use of resources; by focusing the assessment on the key issues it also reduces the length of the environmental information and avoids presentation of irrelevant information.
- It can help in effective management and resourcing of the EIA studies by introducing early planning of activities required to produce the environmental information.

- It can encourage the developer and others to consider possible alternatives and mitigating measures that might reduce the impact of the project.

- When scoping involves consultation with outside bodies it can provide a useful method of establishing contact with other agencies and authorities, interest groups, local communities and the general public. By involving them at an early stage, identifying their concerns and reflecting them in the scope of the EIA, scoping can increase the acceptability and credibility of the EIA and the decision-making process and reduce the risk of opposition emerging late in the day causing delays and costs."

In the information collected through the questionnaire very few mentions are made to the process of scoping. In Finland, for example, the EIA programme has to start from the developer at the earliest possible stage of planning.

III. Consultation

The promotion of public involvement in environmental decision-making is considered as a fundamental instrument in the environmental management and sustainable development. In this sense, the United Nations Economic Commission for Europe (UNECE) issued in 1995 the "Guidelines on Access to environmental information and Public participation in environmental decision-making", calling for an appropriate regulatory framework. These guidelines read:

"States should ensure public participation in environmental administrative decision-making processes preferably by means of explicit rules governing certain procedures such as, if applicable, environmental impact assessment (EIA) and the issuing of permits and licenses, particularly where these may have significant effect on the environment. Those rules could include, inter alia, the right to be heard, procedures which include the right to propose alternatives where feasible, a reasonable time to comment, the right to a reasoned decision and the right of recourse to administrative and/or judicial proceedings in order to challenge failures to act ands to appeal decisions."

"States are encouraged to take as a minimum standard the obligations and recommendations on EIA as contained for example in the Convention on Environmental Impact Assessment in a Transboundary context (Espoo, 1991)"

The EIA provide in general well determined rules for public involvement, though the general opinion is that the process is still insufficient and should be improved.

The EIA legislation in the USA and Canada provides an organized framework for the public participation from the early stages of the process, though in the European Nations, through the application of the EIA Directive, public involvement comes relatively late in the process, having the Member States the right to determine who is the public concerned and the whole process of public participation, what derives quite often in a lack of transparency in the process.

From the experience of the World Bank[8] an effective consultation process is characterised by:

- Wide dissemination of information before consultation begins
- Development of a Consultation Framework (determining at the beginning the issues to be addressed and those not under discussion, the time framework, the sampling of participants, their legitimacy and representativeness, the setting and location for the consultative meetings, the consultation methods and the documentation and dissemination methods, including feedback to those consulted)
- Use of two-way communication with, and wide sampling of, affected people
- Provision of feedback on results of consultation to participants
- Modification of project
- Development of participation plans.

In the same report, the following are identified as key factors in carrying out effective consultation processes:

- Appropriate legislative framework
- Capacity (local) to carry out consultation
- Adequate resources
- Social science expertise

IV. Environmental Studies

It is important to remark that countries which have answered the questionnaire have included those aspects that, according to their experience, are nearly always considered in a typical EIStudy. Just one of the countries, Italy, has submitted those EI that must be included in an EIStudy in a mandatory fashion.

[8] "Public Involvement in EAs: Requirements, Opportunities and Issues", Environmental Assessment Sourcebook UPDATE, October 1995.

Analysing the legal framework of the different countries it is very easy to realize that in the majority of them there are minimum environmental requirements to consider into an EIStudy. This is, for example, the case of the EU Countries whose legal approach is based on the transposition of the European Directive on EIA 85/337 EC. A minimum and rather general approach is justified and even necessary, as the directives must be applicable to a wide variety of conditions, been able the Member States to provide more restrictive requirements on their national legislation. The European Directive on EIA establishes that the EI Study must be able to identify, describe and determine the direct and indirect effects of a project on the following:

- Human beings, fauna and flora.
- Soil, water, air and the landscape.
- The inter-action between the above factors.
- Material assets and the cultural heritage.

Complying with this Directive the Member States, as for example, and with reference to the questionnaire: Finland, Sweden, Spain and Italy; have introduced all these EI in their national legal systems. Member States might even extend this initial list incorporating other environmental aspects that they could consider relevant taking into account their specific peculiarities. This is the situation, for example, in Spain, where the following additional EI have been included in the obligatory environmental aspects to be taken into account within an EIStudy:

- Climate
- Geology
- Structure and function of the ecosystems in the likely affected area.
- Human Health: noise, vibrations, odours and light emissions.

Nowadays, the Council Directive 97/11/EC of 3 March 1997, which amend Directive 85/337 EEC on the assessment on the effects of certain public and private projects on the environment, establishes the following considerations mentioned in the Article 1,

(1) Article 1 (5): The environmental impact assessment shall identify, describe and assess in a appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11, the direct and indirect effects of a project on the following factors:

- Human beings, fauna and flora;
- Soil, water, air, climate and the landscape;
- Material assets and the cultural heritage;
- The interaction between the factors mentioned in the first, second and third indents.

It is necessary to recall that this new Directive is suffering the transposition process by the Member States. In fact, Article 3 establishes that:

"Member States shall bring into force the laws, regulations, and administrative provisions necessary to comply with this Directive by 14 March 1999 at the latest...."

An Environmental Impact Study generally covers the following items:

1. A full description of the proposed project, or activity.

2. -. A statement of the objectives of the proposal.

3. -. An adequate description of the existing environment likely to be affected by the proposal.

4. -. The identification and analysis of the likely environmental interactions between the proposal and the environment.

5. -. The justification of the proposal.

6. -. Economic, social and environmental considerations.

7. -. The measures to be taken with the proposal.

8. -. The consequences of not carrying out the proposal for the proponent, community, region, and state.

V. Post decision monitoring

A well-designed and implemented monitoring program is essential in the EIA processes. It makes it possible to contrast the foreseen impacts with real ones, is a perfect source of knowledge for future projects and permits to measure the effectiveness of the mitigation measures employed if any. Generally the monitoring program is a mandatory requirement in the EIA processes, though many international reviews on the performance of EIAs highlight the weakness of such programs especially regarding its implementation and the responsibilities associated once the project is in the operation phase.

In the EU, for example, the EIA Directive contains no formal requirements as regards monitoring, though most Member States have formal provisions for monitoring required by sectoral laws. The reason can be found in that monitoring must be tailored to the impacts of the project and therefore it cannot be finalised until the licensing process is completed, having after some flexibility in order to adjust monitoring to the actual impacts. Monitoring in a wide sense would include also keeping track of the ongoing environmental impacts associated with project operation and the implementation of mitigation measures, and only of the effects on the environment due to the implementation of the project.

In Japan a new law is to be enforced in summer 1999 including more strict monitoring procedures. Nowadays, the following items are monitored after starting operation: water quality; reservoirs (BOD, turbidity, DO, colon bacillus, total N, total P, etc.); diverted downstream (water temperature, pH, COD, SS, turbidity, colon bacillus, etc.); noise; vibration; others (follow-up and

survey of valuable flora and fauna if necessary.

The post-decision monitoring is often seen as a key piece in the EIA process, permitting to test the effectiveness of the proposed or implemented mitigation, prevention and/or compensation measures and to create a base of knowledge very useful for other projects.

2.3. EIAs and Hydroelectric projects

For a hydroelectric power plant the following economic, social, and environmental elements[9] are to be taken into account and are described in existing guidelines:

1. The contribution to a balanced system for the generation and supply of electricity to meet present and anticipated demand.
2. The alternatives to the proposal by way of alternative sites, alternative ways of generating electricity, or modifying the demand for electricity
3. Hydroelectric power as a form of sustainable development using a naturally renewable resource
4. The consistency of the proposal with national, regional, or local planning instruments; the relationship with national parks, wilderness areas or nature reserves
5. The problem of resettlement if people are to be displaced; the economic consequences of displacement
6. The environmental implications of construction by way of quarrying, road building, seepage, and landslides
7. The housing of the construction work-force
8. The possible geological effects of the dam by way of increased landslip, seepage or seismic activity
9. Water management issues such as the quantity and timing of the release of water
10. The disposal of stagnant water or colder water from the lower layers within the dam
11. The utilisation of impounded water for purposes other than electricity generation, for example, for recreational or irrigation purposes
12. Changes in water characteristics
13. The effects on habitats
14. The effects on fish spawning
15. The effects on animal migration
16. The implications for flood mitigation
17. The problem of siltation
18. The implications of downstream alluvial loss
19. The overall effects on the health of communities immediately affected or downstream; nearby residential districts
20. The implications for vector breeding
21. Potential damage to, or destruction of, archaeological or historical sites

[9] modified from Gilpin,1995

22. The implications for sacred and cultural sites
23. The rotting of vegetative matter drowned under dam waters and the removal of obstacles
24. The reduction in biodiversity and the destruction of wildlife
25. The implication for local industry
26. The implications for ethnic minorities
27. Environmental management of the dam
28. Facilities for monitoring and post project analysis
29. The risks and hazards of a major structure
30. The implications for training
31. The implications for technology in a national context
32. The implications for foreign investment
33. The implications for trade and the balance of payments
34. The political implications of the project
35. The arrangements for continuing public involvement following the initial EIA
36. The proponent's contribution to local infrastructure development and social facilities
37. The implications for aesthetics, amenities, and ecology on: site, and elsewhere; landscaping
38. Electricity transmission lines, easements, and access roads; prospective routes
39. Housing for the permanent workforce
40. Facilities to be provided for tourists; parking
41. Emergency services and responses
42. Clearing of debris after construction, and restoration of vegetation; site rehabilitation
43. Annual report to the environmental, planning, and energy agencies
44. Prospective future developments in the same district, or region, which might suggest cumulative impacts

From that list of elements, the magnitude of the environmental impact assessments can be easily concluded. A lot of elements can be studied and assessed in a procedure of this kind, as the ecosystems, and more specifically in this case the rivers, are extremely complex and in some regions highly variable systems in themselves; and when also social, cultural, economic aspects are to be studied, it becomes a highly time and resources consuming process. Therefore it is extremely important to have an appropriate framework defining what is basic for a project an what can be avoided and focusing on the really key issues to be analysed case by case, in order to minimise the economic and personnel efforts that could make impossible the right development of the proposed infrastructure. That framework is usually established in the form of national or international legislation or guidelines, as seen in the corresponding chapter. In the definition of the formal EIA procedures, the content, timing, competent authorities involved, etc. from the beginning of the process until the permit or license is given are established, and they have to provide a coherent tool for really determining what are the significant impacts of the project and its mitigation and survey.

2.3.1. Hydroelectric projects subject to EIA

The criteria established in the various legislative frameworks studied for determining what kind of hydroelectric projects have to be accompanied by an EIA for its authorisation fall into a wide range. The following table shows the type of hydroelectric projects subject to EIA in the different countries and regions surveyed:

COUNTRY/ REGION	TYPE OF HYDROELECTRIC PROJECTS SUBJECT TO EIA
CANADA (QUEBEC)	For the larger hydro projects, over 10 MW in the Southern region of Quebec and over 3 MW in the northern region of Quebec For the smaller ones, the process is simplified.
FINLAND	Reservoirs with an area > 10 km^2. Additionally for regulation projects where the mean flow of the watercourse is more than 20 m^3/s and the flow and water conditions radically change. Should be also applied for dams that could cause damage to people, their health or property.
INDONESIA	For large hydropower plants, EIA have to be carried out if the height of the dam is >or = to 15 m. Or the reservoir area is >or =to 200Ha. For run-of river projects, >or =to 50MW.
ITALY	For the construction of dams or other plants designed to retain, regulate or store water on a permanent basis, with a height above 10m and/or storage capacity above 100.000 m^3, and of water abstraction exceeding 200 l/s in a National or Regional Park.
JAPAN	Powers Plants for which EIA should be carried out are the hydropower plants of over 30.000 kW, the thermal power plant of over 150.000 kW, and all the nuclear power plants. Actually, electric utilities carry out summary EIA on the hydropower plant of less than 30.000 kW voluntary. There is no difference in procedures depending on size of investments.
KOREA	Projects larger than 3000 kW accompanied with dam or reservoir construction; less than 3000 kW, simplified EIA voluntary
MALAYSIA	Not required
NEPAL	EIA necessary for projects with capacity higher than 5 MW and for all the multipurpose projects. If capacity is 5 MW, an initial environmental examination is required determining after is a full EIA is necessary or not
NORWAY	All applications for hydropower projects bigger than 40 GWh must be followed by an EIA in accordance with the procedures in the Planning and Building Act. Applications for projects smaller than 40 GWh and investment bigger than 50 mill. NKr (7 mill. $) must be followed by an EIA if the Environmental Impacts exceed limits stated in the Planning and Building Act. For all other projects the handling procedures is more simple, then is no need for a notification and the program for impact assessment is decided by NVE without a hearing process.
SPAIN	EIA have to be carried out for big dams (height > 15 m or 10 m< height< 15 m if the capacity of the reservoir is >10^5 m^3) by National law; Regional authorities can settle more restrictive limits, requiring EIAs for smaller projects..
SWEDEN	All hydropower projects
TAIWAN	EIA required if the hydropower plant is in a national park, a wildlife refuge or habitat reserve, a water catchment area for a dam, a tap-water quality and quantity protection area, or has a capacity over 20000 kW.
TANZANIA	All hydropower projects
THAILAND	If storage volume is equal of higher than 100000000 m·3 or surface area larger than 15 km2
USA	The applicable laws and regulations on hydro licensing treat all projects the same with respect to EIAs. In practice the scope of an EA or EIS depends in large part on the size of the project and complexities of the issues. Typically, those issues are negotiated case-by-case with FERC staff.

3. MAIN FINDINGS FROM THE QUESTIONNAIRE

3.1. Introduction

The following conclusions have been selected as being the most useful information found in the questionnaires regarding the original purpose of Subtask IV.

3.2. Time limits

Two countries surveyed reported no time limits, whether for the EIA process or for the hydropower license. Two other countries reported time limits for both the EIA process and the operating license. Another three countries had time limits for either the EIA or the hydropower license.

3.2.1. Time Limits on the EIA Process

Time limits in the EIA process are applied in most cases to the consultation and review phases. One country has a 6 week time limit for comments from the public during the initial phase of the EIA procedure, and 12 weeks for comments during the EIS review. Often, these time limits are associated with public hearings.

In another country, time limits are imposed on both the environmental authority and the public: the environmental authority has 10 days to request public comments on the initial proposal to build a hydropower plant, following that, individuals or organizations have 30 days to voice an objection regarding the project, followed by a time limit of 20 days for the environmental authority to provide an opinion to the proponent specifying the most important aspects (scoping) to be taken into consideration in the EIS. In the same country, there are also time limits of 30 days to receive comments during the EIS review, and the environmental authority has itself 30 days to review the EIS and submit its opinion to the authorizing administration.

One country imposes a time limit only on the Environment Ministry, giving it 90 days to assess the EIS.

Finally, one country imposes a *minimum* time limit of 14 days, to notify the public that a project is proposed (initial stage) and again a minimum of 14 days public notification when the EIS is completed. The same country also imposes time limits of 30 to 60 days on citizen's reviews and opinions, and 1 month for the environmental coordinating authority to issue a statement on the initial scoping for the EIA. A second time limit of 2 months on the same environmental agency also applies following public comments on the EIS.

In summary, time limits are widely used for the EIA process, on both the environmental agencies, and for public or administrative reviews.

3.2.2. Time Limits for the License

4 of the surveyed countries reported time limits for the operating licenses, ranging from 30 to 75 years. Countries where no time limits exist point out however that relicensing or changing the terms of older permits is possible, if for example considerable harm are discovered due to river regulation. Some countries impose time limits on the operating license of private producers, but not on the state-owned utilities.
One country reported that licenses may be issued with a *5 year test-period* in order to review and optimise the mitigation measures.

3.3. Public Participation

All countries surveyed had public participation activities reported in the EIA process.

3.3.1. Requirements for Public Participation

Public participation is generally described in the questionnaire received as steps to provide information and receive comments from the public about a project and its EIS. Information exchange may take several, non-exclusive, channels: publication in local newspapers, distribution of brochures on the project, public announcements, public information meetings, public hearings, inspection proceedings, etc..

3.3.2. Steps for Public Participation

At the *initial phase* of the EIA process 5 countries reported formal mechanisms for public information and comments. In some countries the public input is used to help the environment authority *screen and scope* project impacts.

Countries which have public participation in the initial step of the EIA process usually define specific procedures to inform and receive comments from citizens, groups, and administrative bodies. Time limits are often stipulated for such procedures (see section above).

In one country, the EIA process precedes the permit application. The EIA report must be enclosed with the permit application. Construction of a hydropower plant requires a permit which is determined in a judicial procedure by the Water Court, following the EIA. In this case both the EIA process and the judicial process in the Water Court include public participation steps, at the project notification step, at the EIA report completion, and during the Water Court procedures. The decision of the Water Court to grant or not a hydropower permit may be appealed to the Supreme Water Court, which sets its own hearings. The decision may again be appealed, for good reasons, to the Supreme Administrative Court.

At the *application phase*, all countries reviewed declare having public participation mechanisms. These may be quite informal, stating for example that «anybody can provide the competent authorities with information or recommendations concerning the potential effects of the project on the environment». However most countries surveyed stipulate precise procedure to incorporate the

public comments and views, generally in the form of public meetings or hearings.

Two countries have reported public participation procedures applicable during *the operation phase* of hydropower plants. In one country, if necessary, the local public may request electric utilities to improve the facilities in consideration of the opinions of the local population and committees. In the other country, the local population and the public may initiate a revision of the terms of the license and the rules of operation after a running period of 30 years.

It appears clear, from this review, that public participation is a common tool in the EIA processes of all surveyed countries, but that the way this tool is applied, and the steps to which it applies differ widely.

3.4. Role of Government bodies

Government approval of and influence on the EIA studies must be regarded as important means to secure credibility. (This is in particular the case when public participation is facilitated through review/hearing of the EIA including comments and recommendations from the relevant public, NGOs and authorities.)

In all countries that have answered the questionnaire, the EIA is subject to approval by a competent governmental body. Further the program (TOR) for the EIA study is subject to approval by a competent governmental body in all countries, except two, where the study program is not approved as such, but an applicant for a hydropower licence must prepare an environmental report based on consultations with and recommendations from resource agencies. Failure to do studies requested by agencies can lead to rejection of an application or a request to do additional studies before an application will be accepted for processing.

The questionnaire presupposes that government approval of the studies program (TOR) is given at the "initial phase" of the EIA process. One country has, however, defined the initial phase as the stage before the (final) selection of a project site. In the application phase (after the selection of a project site), the electricity utility submit an EIA report to the Government authority and the concerned local public and population. They examine the EIA report in accordance with an Environmental Examination Guideline, and in consideration of the opinions of the ministries concerned, experts, the local public and population, and may at this stage order electric utilities to revise the EIA report if found necessary.

Although not being subject to (formal) approval in two cases, it can be concluded that the program (TOR) for the EIA study is subject to government scrutiny and influence in all the countries that have answered the questionnaire.

3.5. Study carried out by an independent body

This subchapter analyses the role of the institution or company who do the EIA: Are they independent from the hydropower developer?

To avoid conflict of interest and increase the credibility of EIAs, it has been discussed whether the assessments should be carried out by an institution that is independent from the hydropower developer. As an example some government agencies have specific requirements regarding independence for the EIA study.

On the other hand it is often a weakness with the EIA process that it is carried out separate, in time and/or institutionally, from the project design. According to a study made by the World Bank only 9 of 53 projects reviewed were modified significantly regarding location, size or major design as a result of the environmental assessment findings (cf. World Bank, Operation Evaluation Department, Dec.96. Environmental assessments and national action plans). Most projects will benefit from a close co-operation between the people working with the technical plan and the environmental team. A continuous process, where the project design is changed depending on the environmental assessment findings, can facilitate the identification of optimal adjustments, from both an environmental and technical/economical point of view, to minimise the negative impacts of a project.

There is not a requirement in any of the countries have answered the questionnaire that the EIA has to be worked out by an independent body. The advantage of an EIA process that is integrated in the project design is emphasised in some answers to the questionnaire.

3.6. Present use of plans

EIA are usually related to projects or to a strategic level. An EIA could be strategic in different ways: it could include a whole river catchment, sectoral - ia related to energy policy - and crossectorial related to conservation of nature, water resources etc. A strategic EIA could also be used as a tol for screening and scoping.linked to project related EIA.

From the countries and regions surveyed just one has no demand for strategic studies.

Some countries have a strategic and development plan for hydro subject to governmental approval, or have a master plan for the remaining hydropower potential. The aim is to make a priority list for developing of projects with less environmental impacts first. Most countries have demand on a river basin management plan and water management plan but make not more detailed comments about it. The case has also been reported where a master plan was approved by Parliament, but due to public resistance it has not been possible to impement it.

3.7. Study of alternatives

Study of alternatives mean different things in different countries, it could be alternative sites for hydro in a river catchment or alternative ways to produce electricity. In some countries also 0-alternative is demanded - the consequenses of doing nothing. Most countries have demand on studies about alternatives.

3.8. Assessment of cumulative impacts

An operation that itself has perhaps merely insignificant impacts may increase the common impacts of earlier operations to a level where the bearing capacity of the environment becomes unstable. Consequently it is vital, that cumulative changes apparent in nature, which have resulted from various projects are described and analysed. The assessment of cumulative impacts strives to clarify the pressures concentrated on the environment, which may accumulate in the long-term, and to geographically large areas.

The assessment of cumulative environmental impacts is a question of a comprehensive nature-based approach. The assessment will strive to inspect environmental impacts on a wide scale in place of inspections based merely on individual projects or sectors.

The occurrence of change in the environment may lead to:

- operations realised by the same or various operators, concurrently or successively
- operations realised by the same or various operators non-concurrently and in different locations
- operations consequenting from universal, temporal and localised decentralised events

The very fundamental requirement should be that the cumulative impacts of various operations should be considered in planning of land use and resources. The assessment of cumulative impacts on the project level aids the project and the application of the impacts with a wider ecological connection.

3.9. Mitigation and compensation measures

In all the regions surveyed the EIAs require the implementation of measures for the mitigation of the possible negative effects of the project on the environment. In some cases a test period is established to optimise these measures. Few regions apply the existing experience in mitigation measures to other projects.
ST6 deals more in depth with mitigation measures, but according to ST4 survey, the following are the most common:

– Guaranteed minimum river flows for biological, aesthetical or navigational reasons are

required in all the cases.

- The use of measures and techniques for protecting fish are very common (especially from being entrained into the turbines, fish ladders, fish stocking), while the techniques of habitat adjustment in the river are a less required practice.
- Other common measures are related to landscaping, flow variations, noise reduction, protection of flora, etc.

The subtask VI covers the issue of mitigation measures focusing on its efficiency, present use and availability more deeply.

3.10. Relicensing and upgrading

Though the concept of project specific EIA refers to the assessments of the significant effects on the environment of a future project, the process is in some cases applied for the situations of relicensing (where a project has been functioning for a considerable number of years, and therefore the impacts on the environment are quite obviously different) and upgrading.

The purpose of this chapter is to analyse the differences observed in EIA requirements in the case of "relicensing and upgrading" situations in contrast to new projects

In order to clarify the concepts, in the context of this chapter, the following definitions apply:

Relicensing : for those countries where a licensing procedure is required and given for a limited period of time, relicensing should be understood as the process of renewal and /or extension of the license when the time period expires.

Upgrading : the activities as restoration capacity, renewal, rehabilitation, refurbishment, up-rating, enlarging and redevelopment are upgrading activities, contrary to maintenance on the one hand, and new projects on the other hand.

Regarding the scope and the process of EIA in those specific situations, there are not relevant differences according to the information collected in the questionnaires.
Therefore, it seems that generally, the legislative framework is the same as for new projects when the proposed changes for upgrading are important and affect, specially, water levels or flow discharges.

Relicensing :

The licenses for water use are given in different conditions through the regions surveyed in the questionnaire. Some countries or regions don't have relicensing processes for the hydropower installations, the certificates of authorisation being not granted for a limited period of time, though in other it is possible to revise old, previously permanent regulation permits on environmental reasons. In other countries or regions the licenses are given for a certain period of time ranging from 30

years, when there is a requirement of updating the exploitation conditions, to cases where there is not a clear relicensing process, as the licenses are given for a period of 75 years, after when the installation (intake works, flow regulating works, pipes and discharges works, etc.) becomes property of the State without any compensation.

A case has been reported where after 30 years of exploitation of the plant, the parties concerned must carry out investigations and analyses on certain issues as transportation by ship, fishery, landscape, prevention of salt damage (prevention of reversed current of sea water at the river mouth), prevention of clogging caused by the accumulation of sand at the river mouth, maintenance of underwater level (prevention of a drop in the groundwater level), protection of fauna and flora and maintenance of cleanliness of flowing water (prevention of water quality deterioration).

In all these cases there is not a formal requirement of an EIA. Just in one country the relicensing process requires the same EIA than a new project. New legislations are apearing establishing the requirement of fulfilling a complete EIA in the case or relicensing hydropower plants.

Upgrading :

Concerning upgrading, the scope of EIA is defined with relation to the proposed changes, being . relevant changes in flows or water quality are specially mentioned. In the majority of cases the same regulations apply for EIA as in new projects, though in many cases EIAs are required given the occurrence of a certain previous condition, for example, an enlargement of over 10 Mw, major changes in water quality or alteration of flows or in the case of major projects. One country requires an study of environmental integration into the landscape but not a formal EIA if the intake and the dam essentially remain unaltered. Only one country reported that the limit in order to define the scope of EIA is related to the power sough (30 Mw). In other cases, depending on the scope of any upgrade which is proposed. The regulatory body decides about the proposal regarding an environmental report prepared by itself and other environmental report prepared by the applicant.

4. CONCLUSIONS. APPLICABILITY AND EFFICIENCY OF THE PROCESS

The following are the conclusions concerning the applicability and efficiency of EIA process showed in ST4 questionnaires. Though they respond to qualitative data, the opinions expressed in the questionnaires have been collected among experts and approved by the National Representatives in order to guarantee their credibility. From the opinions collected in the questionnaires it can be said that the countries that have more years of experience with EIAs in hydropower plants find in general the process to be excessively time consuming; they also point out the lack of co-ordination among the different authorities involved, coming sometimes to discrepancies that result in time consuming processes and risks that are assumed by the proponent. Another generally agreed weakness of the process is the fact that the knowledge derived from previous EIAs, that could save economic and human resources, is generally not used in new projects. Also the process of identifying really significant impacts to be studied seems to be very weak, often making the studies very little focused on what really matter. Nevertheless, some countries have reported to have a very efficient process.

Some countries mention the change occurred in its legislation concerning the inclusion of the environmental aspects as a result of the growing public interest especially in the 1970s and in 1980s, when the leisure time and the multiple use of the watercourses and nature became important issues for the society. Then, the requirements of assessing the effects of projects on the environment became more and more stringent. In this sense, the Environmental impact assessments, now widely used worldwide have been a very useful tool functioning effectively with regard to the preservation of the ecosystems as some countries have noticed. The following positive aspects reported in the questionnaires can be highlighted

- The EIA process prevents and mitigates adverse impacts of development activities to attain the goal of environmental protection.
- The interest of the experience and the accumulated knowledge in the course of time
- A gradual improvement of the environmental optimization of the projects.
- An increasing participation of the public in the process.
- A stronger awareness of the promotors and the competent government bodies.
- An appreciation of the scientific, expert and people interest in the EIA process.
- A rise of the transparency of the process.
- The important role of the EIA together with experience from existing mitigation measures in deciding on mitigating measures and reducing the impacts.
- The old permits for regulation have been rather controversial on the regulated watercourses, especially when the use of the watercourses has considerably changed. This has resulted in the adjustment of old permits.

Nevertheless, the majority of the countries surveyed have reported ineffeciencies of the process that to some extent minimise the original objective of the EIA and make difficult its implementation, in many cases even hindering the development of new hydropower projects. In this sense after the incorporation of the EIAs, the authorisation procedures for hydrpower plants, being *per se* very slow have resulted in even more time consuming, processes requiring and average time of 5 to 12

years in some countries. This appears to be due to a restrictive interpretation of the laws in force. Also in some countries, as no deadlines are set for most steps in the process, opponents of projects can drag out the process. In practice, a large hydroelectric project could require up to eight years between the notice of intention and the authorisation to begin building.

Another bottleneck in the process is the lack of co-ordination between the different authorities involved at national, federal, regional and/or local level. Hydroelectric power plants are subject to a sophisticated legal framework for both their development and their operation. Overall, approval mechanisms are cumbersome and complex, involving usually several different parties, thus causing serious problems for proponents.

In some countries the reason is that for the works of public interest, the laws allocate the competence to the State, aiming to safeguard national interest over local interest, but the normal procedure for town-planning authorisation lies in the competence of regional or local authorities; an agreement then is necessary through the consensus of all the administrative and government bodies involved, but if opinions diverge the town-planning authorisation procedure is usually repeated several times. As the various federal, provincial and regional processes are not harmonised, the proponent must strive to co-ordinate the steps in the different and co-ordinate the work of all parties at the different steps in each procedure. Ultimately, a project may be approved by one authority and rejected by another. This adds to the risks a proponent assumes.

Even more, there is an existing trend of denying the approval of the construction of new hydropower plants due to a growing awareness of the environment which is becoming more widespread, causing a standstill in hydropower development in some countries.

This lack of harmonisation among the different authorities involved in the process is identified in some cases as the real origin of a very inefficient process, often requiring additional data or the re-examination of the whole evidentiary record. When extensive hearings are added, the entire process can take several years.

This problem seems to be solved to some extent in certain cases with a requirement that applicants consult in advance of the preparation of any license application, with state and federal resource agencies regarding the impacts of a project and the kinds of studies which should be done to investigate those impacts. This process tends to produce an early examination of the hard environmental issues and to focus the applicant on mitigation measures that would be appropriate in the circumstances. There is a case where the national regulatory authority has been urging applicants to develop a collaborative process whereby all of the so-called stakeholders, namely, the resource agencies, environmental groups, land owners and other interested groups work with the applicant on a regular basis to develop studies, review the data, propose license conditions and to reach a settlement agreement in advance of the filing of any license application, so that the process can go forward much more quickly.

Concerning the EIA process, the existing guidelines for impact assessment studies often provide an exhaustive, even encyclopaedic list of every study that could possibly be conducted regarding a

project. No effort seems to be made to direct the focus onto the key issues. It is a challenge for the responsible governmental body to reduce the content of the EIA to the important issues in many countries. Too big EIAs have big costs, is time consuming and the important information may drown in a lot of less important documentation. There is a common agreement that the EIA should be a more focused process, starting with the more crucial problems and going down to minor problem and that the many studies completed over the years should help limit the subject of the studies proposed so that social and environmental acceptability can be decided by the key issues rather than by secondary concerns posing little environmental risk.

Another weakness in the EIA process refers to the monitoring and surveillance programmes due to the lack of awareness of the cost of implementing them, a lack of control of the monitoring and surveillance program or a lack of funding. There is also a feeling that not so much efforts are put on this step of the process.

Other identified weaknesses in the questionnaires refer to the low public participation , the lack of enough qualified and multidisciplinary teams of experts in some countries, the scarce resources available for the studies, the consideration of the process as a mere administrative step and the absence in many cases of a serious alternatives study.

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6. GLOSSARY

Anthropogenic: Induced or altered by the presence or activities of humans.

Alternatives study: The part of an EIA where alternative sites, methods and techniques for a particular project are studied included the zero alternative or alternative of not proceeding with the project as initially planned.

Application phase: The initial phase of EIA where a proponent seeks for the approval of a project.

Biotope: A physical habitat that has fairly clear boundaries and a strictly defined composition, and supports species that constitute a community.

Capacity: The maximum sustainable amount of power that can be produced by a generator or carried by a transmission facility at any instant. Usually measured in megawatts (MW)

Catchment: The area which drains naturally to a particular point on a river.

Compensation measure: Measure sought to compensate for impacts that cannot be mitigated and for residual impacts of the project after the implementation of mitigation measures.

See *Mitigation measure. Enhancement measure.*

Cumulative impact assessment: The assessment of the impact on the environment which results from the incremental impact of an action when added to other past, present or reasonably foreseeable actions regardless of what agency or person undertakes such actions. Cumulative impact can result from individually minor but collectively significant actions taking place over a period of time.

For example, a single automobile causes relatively minor impacts, whereas a million automobile cause significant cumulative impacts (on air quality, petroleum ressources, etc.)

Decommissioning: For hydroelectric powerplants, refers to a permanent end to electricity generation, generally at the end of the plant's useful life. Decommissioning may involve dismantling of the generation equipment, and / or removal of the dam.

Design criteria: Principles, rules or standards guiding our judgments on the suitability of outlines, sketches, or plans as of an edifice, or a machine to be executed or constructed.

Discharge: The volume of water flowing at a given time, usually expressed in cubic meters per second.

Diversion: The act of redirecting part or all of a river's flow into another river

or reservoir.

Ecological flow: The fraction of stream flow released through a hydroelectric dam specifically to meet the needs of downstream users and/or habitats

Ecosystem: The complex formed by living organisms (community) and the physiochemical environment in which they live (biotope).

Energy: 1. Force or action of doing work. Measured in terms of the work it is capable of doing; usually electric energy is measured in kilowatt-hours (kWh).

Enhancement measure: Measure used to improve existing environmental or social conditions which are not directly affected by a hydropower project. Such measures may be implemented outside of the project area.
See *Mitigation measure, compensation measure*. See also Subtask 6 report.

Environmental Assessment (EA): The systematic, reproducible and interdisciplinary identification, prediction and evaluation, mitigation and management of impacts from proposed development and its reasonable alternatives.

Environmental Impact Assessment: Following the definition made in the EU Directive 85/337/EEC of 27 June 1985, applies to the identification, description, and assessment of the direct and indirect effects of a project on: human beings, fauna and flora; soil, water, air, climate and the landscape; the interaction of these factors; and on material assets, and the cultural heritage.

Environmental Impact Statement: A document prepared by a developer applicant describing a proposed policy, program or project; alternatives to the proposal, and measures to be adopted to protect the environment. It is then a step into the EIA process. The document is then subject to an EIA. In some countries it is known as EIA report and/or Environmental Impact Study. In other countries the Environmental Impact Statement refers to the final resolution concerning the feasibility of the project coming from the environmental authority.

Eutrophic: Of a body of water: characterized by the state resulting from eutrophication.
See *oligotrophic*

Eutrophication:

1. A process where more organic matter is produced than existing biological oxidization processes can consume.
2. The processs of fertilization that causes high productivity and biomass in an aquatic ecosystem. Eutrophication can be a natural process or it can be a man-made process accelerated by an increase of nutrient loading to a lake by human activity.
3. Process of nutrient enrichment of a body of water. In

advanced state, causes severe deoxygenation of the water body.

Evapotranspiration: Joint effect of the loss of water to the atmosphere from the soil surface (evaporation) and from the plant surface (transpiration)

Ex-post evaluation: Done, made or formulated after the fact, to determine the significance, worth or condition by careful appraisal and study.

Flood control: Reducing the risk by building dams and /or embakments and/or altering the river channels.

Flood management: Reducing flood risks by actions such as discouraging floodplain development, establishing flood warning systems, protecting urban areas and isolated buildings, and allowing the most flood prone areas to remain as wetlands.

Flood releases: Releasing large volumes of water form a reservoir to simulate natural flooding conditions.

Floodplain: Level land that may be submerged by floodwater.

Fry: A newly hatched and incompletely developed fish depending on its yolk sac for nourishment and still living in its nest or inactive on the bottom

Generation: The act or process of producing electrical energy from other forms of energy. Also refers to the amount of electrical energy so produced.

Groundwater: Subsurface water contained in saturated soils and rocks.

Hearing: A process by which the public, organisations, etc. Can express their opinion on the project seeking approval and the associated environmental studies.

Hydroelectric: The production of electrical power through use of the gravitational force of falling water.

Hydrological cycle: The continuous interchange of water between land, sea or other water surface, and the atmosphere.

Impact management plan: A structured management plan that outlines the mitigation, monitoring and management requirements arising from an environmental assessment.

Impact monitoring: Monitoring of environmental/social/health variables, which are expected to change after a project has been constructed and is operational, to test whether any observed changes are due to the project alone and not to any other external influences.

Impounding: Creating a body of water (impoundment zone) by the construction of a dam.

Initial environmental evaluation/ examination:	A report containing a brief, preliminary evaluation of the types of impacts that would result from an action. Often used as a screening process to assess whether or not proposals should undergo full scale EIA.
Integrated resource planning (IRP):	A planning process aimed at minimizing the costs of providing energy serices by explicit consideration of all known resources for meeting the demand for such services, including alternative supply resources as well as DMS.
Kilowatt (kW):	A unit of electrical power equal to 1,000 watts (equivalent to about 1.3 horsepower)
Kilowatt-hour (kWh):	A basic unit of electrical energy equivalent to one kilowatt of power used for one hour.
Large dam:	For the purpose of inclusion in the ICOLD World Register of Dams, a large dam is defined as any dam above 15 meters in height (measured from the lowest point of foundation to top of dam) or any dam between 10 and 15 meters in height which meets at least one of the following conditions a) the crest length is not less than 500 meters; b) the capacity of the reservoir formed by the dam is not less than one million cubic meters; c) the maximum flood discharge dealt with by the dam is not less tha 200 cubic meters per second; d) the dam had specially difficult foundation problems; e) the dams is of unusual design.
Licensing:	The administrative procedure followed to obtain the authorisation by the competent administrative body for the construction and operation in this context of a hydroelectric power plant.
Limnology:	The scientific study of bodies of freshwater (as lakes).
Macroinvertebrates:	Aquatic organisms without vertebrae that can be seen with the naked eye. Macroinvertebrates usually live under rocks or in the bottom substrate. Most of them are aquatic insects or the aquatic stages of insects, such as stonefly nymphs, mayfly nymphs, dragonfly nymphs and midge larva. They also include such creatures as snails, clams and aquatic worms.
Megawatt (MW):	A megawatt is one million watts, a measure of electrical power.
Megawatt-hour (MWh):	A unit of electrical energy equivalent to one megawatt of power used for one hour. Gigawatt-hour (GWh) and Terawatt-hour (TWh) are one billion and one trillion watts of power used for one hour.
Mitigation measure:	Measure used to eliminate a source of impact or reduce its intensity to an optimal or acceptable extent. These measures are applied in the immediate work site area or in sectors that will directly

	experience the effects of hydroelectric development. *See compensation measure. Enhancement measure.*
Oligotrophic:	Deficient in plant nutrients. Especially: having abundant dissolved oxygen- an oligotrophic body of water.
Phytoplankton:	Planktonic plant life.
Pisciculture:	Breeding, rearing and transplantation of fish by artificial means (fish farming).
Power:	Electrical energy generated, transferred, or used; usually expressed in kilowatts or megawatts.
Pumped-storage plant:	A hydroelectric power plant that generates electrical energy to meet peak load by using water pumped into a storage reservoir during off-peak periods.
Refurbishment:	Activity returning something to its original state. Refurbishment is generally aimed at restoring the plant to close to "as new" condition and performance with a view to reducing ongoing maintenance costs and extending plan life by a specified period, typically 25 years and up to 50 years.
Regional environmental assessment (REA):	An environmental appraisal procedure applied to a relatively large geographic area that examines the likely impacts of sector-wide programs, multiple projects or development policies and plans.
Regulated river:	River of which the natural flow pattern is altered by a dam or dams.
Relicensing:	In some countries (e.g. USA) the license for operating a hydroelectric equipment has to be renewed after a certain period encompassing generally the plant's useful life (30-50 years). Relicensing is hence a procedure for processing a new license. The procedures are practically identical to those for an original license. In any license issued, the concerned agencies include terms and conditions (license articles) that are the requirements a licensee must comply with to keep the licence in effect. These requirements include engineering, safety, economic, and environmental matters. For example, they could include requirements for water quality monitoring, wildlife habitat conservation, a public safety plan, an erosion control plan, and engineering design drawings and specifications.
Renewable resource:	A power source that is continously or cyclically renewed by nature. A resource that uses solar, wind, water, geothermal, biomass, or similar sources of energy.
Reserve capacity:	Generating capacity used to meet unanticipated demands for power or to generate power in the event normal generating resources are not available.

Reservoir area:	Areas which are converted from land, wetland or watercourse to an impoundment for storage of water, for use by the hydropower station. Includes the riparian zone.
Reservoir storage:	The volume of water in a reservoir at a given time.
Riparian:	Of, on, or pertaining to the bank of a river, pond or lake.
Risk assessment:	Assessment methodology used to estimate the frequency and severity of adverse events and to present the results in a form useful to management.
Riverine ecosystem:	Zone of biological and environmental influence of a river and its floodplain.
Run-off:	Precipitation which drains into a watercourse rather than being absorbed by soil.
Scoping:	An early and open activity to identify the impacts that are most likely to be significant and require investigation during the EIA work. Can also be used to: – Identify alternative project designs/sites to be assessed – Obtain local knowledge of the site and surroundings; and – Prepare a plan for public involvement The results of scoping are frequently used to prepare the terms of reference for the EIA
Screening:	Preliminary activity undertaken to classify proposals according to the level of assessment that should occur.
Sectoral environmental assessment:	An environmental appraisal procedure applied to a specific sector of the economy (energy, transportation, health, etc.) that examines the likely impacts of sector-wide programs, multiple projects or development policies and plans.
Sediment:	Mineral and organic matter transported or deposited by water or air.
Storage reservoirs:	Reservoirs that have space for retaining water from high flow periods (spring snow melt, monsoons, etc.). Retained water is released as necessary for multiple uses – power production, fish passage, irrigation, and navigation.
Strategic environmental assessment (SEA):	An environmental appraisal procedure that examines the likely impacts of proposed policies, programs and plans. Typically applies to government or corporate policy-making.
Terms of reference:	Written requirements governing EIA implementation, consultation to be held, data to be produced and form/contents of the EIA report. Ofter produced as an output from scoping.
Thermal power plant:	A facility that uses heat to power an electric generator. The heat

may be supplied by burning coal, oil, natural gas, biomass or other fuel: by nuclear fission; or by solar or geothermal sources.

Thermal stratification: The tendency in deeper lakes for distinct layers of water to form as a result of vertical change in temperature and therefore density.

Trophic level: A level in the movement of matter and energy along a food chain or through a food web.

Turbid: Of a body of water: thick or opaque with sediment

Turbine: Machinery that converts kinetic energy of a moving fluid, such as falling water, to mechanical power, which is then converted to electrical power by an attached generator.

Upgrading: The activities as restoration capacity, renewal, rehabilitation, refurbishment, up-rating, enlarging and redevelopment are upgrading activities, contrary to maintenance on the one hand, and new projects on the other hand.

Utility: A business organization (as an electric company) performing a public service and subject to special governmental regulation.

Water retention time: Theoretical residence time of water in a reservoir. Period during which water remains in a reservoir.

also: water renewal time.

Watershed: Area drained by a river. (Catchment area)

Watt-hour: Unit of energy (Wh) equivalent to the power of one watt over a period of one hour.
One kilowatt-hour (kWh) is equal to one thousand watt-hours. One gigawatt (GW) is equal to 1 million watts. One terawatt (TW) is equal to 1 billion watts.

Watt: Basic unit of electrical power.
One kilowatt (KkW) is equal to 1 thousand watts. One gigawatt (GW) is equal to 1 million watts. One terawatt (TW) is equal to 1 billion watts.

Weir: A low dam or wall across a stream to raise the upstream water level. Termed fixed-crest weir when uncontrolled.
A structure built across a stream of channel for the purpose of measuring flow. Sometimes described as measuring weir or gauging weir, drowned weir or submerged weir.

Wetland: Area of land which is seasonally, intermittently or permanently waterlogged.

Zooplankton: Plankton composed of animals.

7. ACRONYMS

BOD: Biological oxygen demand
DGXI: Directorate General XI of the European Union: Environment
DO: Dissolved oxygen
EA: Environmental Assessment
EC: European Community
EIA: Environmental Impact Assessment
ES: Environmental Statement
EIS: Environmental Impact Study
EPA: Environmental Protection Agency
EU: European Union
FERC: United States of America Federal Energy Regulatory Commission
GIS: Geographic Information System
IEA: International Energy Agency
NEPA: National Environmental Policy Act
NGO: Non-governmental organization
PPA: Post-project analysis
REA: Regional Environmental Assessment
SEA: Strategic Environmental Assessment
SS: Suspended solids
TOR: Terms of Reference
UNECE: United Nations Economic Commission for Europe
WP: Water Plan

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