

## ***Hydroelectric power stations and large dams***

---

### ***Use of environmental guidelines***

Coface environmental guidelines are aimed at clarifying, on a sector by sector basis, the criteria used in the environmental review of major projects undertaken by Coface on behalf of the government. They identify the main impact factors of a project within a given sector on the environment and, for each of these factors, define three categories of criteria: reference criteria, target criteria and best practice criteria. These categories have the following significance:

- when Coface considers that the reference and target criteria have been met in full, the project is considered to be acceptable from an environmental point of view;
- when a project does not satisfy the reference and target criteria, its acceptability from an environmental point of view is assessed on an individual basis by Coface experts, taking into account the specific nature of the project. If the reference criteria are not complied with, the impact of the project on the environment is not deemed acceptable, except if it appears that the criteria can't be met within the project's specific conditions. Where appropriate, guarantees for the project in question may be subject to mitigation and/or compensatory measures being taken;
- best practice criteria advocate the use within a project of the best available technology or practices from an environmental point of view, which Coface wishes to encourage.

Environmental impacts should be understood in a broad meaning, and include, where appropriate, impact on local population.

However, in the particular case of a hydroelectric power station or dam project, there are no internationally recognised quantitative standards, such as World Bank guidelines, on which to base the definition of the levels of acceptability of the impact of this type of project on the environment.

All reference, target and best practice criteria are therefore derived from a qualitative approach. These criteria are, in particular, based on the work of the International Commission On Large Dams (ICOLD), the International Energy Agency (IEA), the World Commission on Dams (WCD) and Operational Directives 4.00, 4.01 and 4.30 of the World Bank.

They are supplemented by indicators that enable a comparison between the potential impact of different projects on the environment. However, the relevance of these indicators varies from one project to another and their application cannot be taken as a final assessment of a project's acceptability from an environmental point of view.

### ***Scope***

These guidelines apply to projects that involve the production of electricity from the gravitational flow of water into one or more turbines, with a total capacity of over 50 MWe and/or requiring the construction of a new dam of over 15 metres in height (in relation to foundations), or a dam of between 5 and 15 metres in height with a reservoir of over 3 million m<sup>3</sup> (*definition of large dam according to the ICOLD*).

For projects that, according to this definition, require the construction of a new large dam, an Environmental Impact Assessment is required.

### ***Main impact factors***

A large dam, by modifying the morphodynamic and hydraulic characteristics of the flow of water, can have a potentially sizeable negative impact on indigenous populations and ecosystems. In particular, flooding an area to be used as a reservoir may require the involuntary resettlement of people, may impoverish or destroy land and aquatic ecosystems upstream of the dam, may contribute to spread of infectious diseases (such as malaria) and may seriously degrade the quality of the water. Changing the flow of water may also compromise the use of the water downstream, having a major effect on dependent ecosystems. Lastly, the build-up of sediments around the dam may result in downstream erosion, as well as at estuaries.

Some of the impacts of a large dam on the environment may, however, actually be sought after because of their beneficial effects. This is particularly true when it comes to the control of water levels, the supply of drinking water, irrigation and the management of electricity networks.

Lastly, the negative impacts of large dams needed to operate hydroelectric power stations may prove less than those generated by another means of producing electricity. In particular, hydroelectric power stations have the following advantages over conventional power stations:

- no consumption of non-renewable natural resources;
- generally lower emissions of greenhouse gas than thermal power stations;
- absence of atmospheric pollutants or liquid effluents likely to contaminate surface or underground water supplies.

Whatever the goods or services exported, all of these impact factors are analysed by Coface. If the goods or services are deemed to only play a marginal role in relation to the project as a whole, this situation is nonetheless into account in the conclusions of the environmental review.

It should be noted, moreover, that the overall benefit ratio in environmental terms of a large dam may, depending on the aim in question, and particularly when the aim is to produce electricity, be globally positive or negative depending on the location of the dam and measures taken to avoid, mitigate or compensate for undesirable effects.

An analysis of the feasibility of alternatives is therefore recommended<sup>1</sup>, based where appropriate on the use of other energy sources, particularly the use of renewable energy with a potentially lesser impact.

*As such, the primary criteria used by Coface in the environmental review of a large dam project are the following:*

#### ***Criteria No. 1: choice of an operating method and a site that will have as little negative impact on the environment as possible.***

The aim of this criteria is to guarantee that a project is as acceptable as possible from an environmental point of view. It is therefore recommended to provide all the necessary information indicating that alternative sites and operating methods have systematically been explored and, in particular, that a slight change to the project (change in the height of the dam, for example) would not result in avoiding major impact on the environment (change in the number of people having to be resettled, for example).

For all major projects, particular attention is paid to the extent to which any large-scale negative impacts can be reversed.

Table 1 below lists the impacts that are taken into consideration and, insofar as they are relevant to the project concerned, the indicators used to assess their scope.

---

<sup>1</sup> This analysis of the different options is part of the Environmental Impact Assessment (EIA) such as it is defined in Operational Directive 4.01 of the World Bank.

**Table No. 1: indicators used to assess the negative impacts of a large dam**

Impact factors	Indicators	Notes
Flooding of a reservoir: - involuntary resettlement  - destruction or degradation of nature reserves, cultural heritage sites or the habitat of a particularly vulnerable social group  - cutting off effect	<ul style="list-style-type: none"> <li>• surface area of the reservoir flood zone</li> <li>• number of people having to be resettled</li> <li>• surface area of the flood zone x valuation index<sup>2</sup></li> <li>• surface area of the flood zone compared with the average flow of water width before the project</li> </ul>	<p><i>For hydroelectric projects, indicators relating to the surface area flooded and the number of people having to be resettled are also compared with the power capacity (MWe) and output of the power station (GWh)</i></p> <p><i>The flooding of an area may be compensated for by the creation of a fishing, tourist or ecological site.</i></p> <p><i>The use of this indicator is only valid where a cutting off effect is likely to affect populations and/or ecosystems.</i></p>
Risk of eutrophication of the water in the reservoir	<ul style="list-style-type: none"> <li>• depth of the reservoir</li> <li>• useful capacity of the reservoir compared with the annual flow of water</li> </ul>	<i>This circulation indicators may be supplemented by water quality indicators on a case-by-case basis</i>
Modification of the hydraulic regime downstream of the dam	To be assessed on a case-by-case basis, according to the hydrological configuration of the water flow and its value (including biodiversity) and use (including fisheries and cultivation).	<i>Changes to the hydrological regime downstream of the dam are sometimes included in the aims of the dam.</i>
Risk of sedimentation at dam level and downstream erosion	To be assessed on a case-by-case basis according to the configuration of the catchment area and downstream flow	

***Criteria No. 2: implementation of an environmental management plan enabling unavoidable negative impacts to be minimised.***

For projects with a potentially high impact, the implementation of an environmental management plan is required.

It is recommended that this plan include the following elements, where relevant to the project concerned:

- *an environmental management of flows, to reproduce the flows of the existing regime before the construction of the dam (including, where necessary, controlled flooding), with the aim of preserving ecosystems and uses of water downstream;*

To this end, an analysis of the existing situation and the sensitivity of the ecosystem and uses of the water downstream prior to any change in the hydrological regime is required for large dam projects. This is normally carried out as part of Environmental Impact Assessment.

<sup>2</sup> Valuation index, taken from the outcome of the Gland Workshop, is defined as follows:

1 : area with no particular value from an agricultural, aesthetic or cultural heritage point of view

2 : agricultural area

3 : protected ecosystems

4 : ecosystem with high biodiversity

5 : nature reserves, cultural heritage sites or site particular importance to ethnic groups

If the review ascertains that a given area is particularly sensitive, flow management scenarios should be drawn up and a given scenario integrated within the environmental management plan.

- *monitoring of water quality in the reservoir and, where necessary, the implementation of appropriate measures to minimise this impact;*

In this respect, it should be noted that the main factor likely to affect the quality of the water in the reservoir is the retention time, which may lead to a substantial reduction in the quantity of oxygen dissolved, the eutrophication and thermal stratification of the water, and even an increase in the concentration of toxic pollutants (due to the anaerobic conditions of the decomposition of underwater organic matter, or the introduction of pollutants and sediments in the catchment area).

This deterioration not only has a direct impact on ecosystems and uses of water within the reservoir, but also, due to the discharge of turbine water, on the quality of water downstream (temperature, oxygen and toxic pollutant content).

It is therefore recommended that, when significant damage to the quality of the water is foreseeable, the following measures be included in the environmental management plan in order to minimise their impact:

- complete or partial cleaning of the zone to be flooded before filling the reservoir;
- catchment of the water at variable points, the re-oxygenation and increase in temperature of turbine water;
- and control of pollution and erosion of the river basin.

- *environmental management of the build-up of sediment in the reservoir, including, when technically possible, a periodic and controlled discharge.*

This periodic discharge is essential in order to limit erosion downstream of the dam and thus protect the alluvial areas necessary for the proper functioning of certain ecosystems or agricultural activities, as well as the quality of the water in the reservoir.

It is therefore recommended that, where required given the quantity of sediment likely to build up in the reservoirs, the techniques for said discharges be listed in the environmental management plan.

More generally, the extent to which an environmental management plan is adapted to the impact of the project concerned is assessed on a case-by-case basis.

***Criteria No. 3: adequate compensation for impacts that can be neither avoided nor minimised.***

Insofar as the choice of site and method of operating the dam are likely to have a major impact that can be neither avoided nor minimised, adequate compensation must be provided, in particular:

- *compensation and/or resettlement of project affected people in the best conditions;*

A plan to compensate and/or resettle project affected people is required. This plan must be drawn up in accordance with the principles of World Bank Operational Directive 4.30 / Operational Procedure 4.12 In particular:

- ❖ the plan should include appropriate measures to compensate, at full replacement cost and before the damage takes place, any loss attributable directly to the project. The absence of legal title to land by adversely affected people should not be a bar to compensation;
- ❖ displaced people should be assisted with the move, and, where appropriate, for instance in case of a “land for land” approach, provided with land and housing in a site where productive potential and locational advantages are at least equivalent to those of the old site. Preference should be given to “land for land” approach for displaced persons whose livelihoods are land-based;
- ❖ displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels. It may therefore be needed to offer them support after displacement, for a transition period.

- ❖ in new resettlement sites, infrastructure and public services are provided as necessary to improve, restore, or maintain accessibility and levels of service for the displaced persons. Displaced people should also be provided sufficient investment resources and opportunities to share in project benefits (such as employment, electricity, right of use,...);
- ❖ the consultation/participation of those populations affected by the project must be accounted for in the plan;
- ❖ a calendar and deadline must be defined for the effective implementation of advantages for any affected person.

The extent to which each compensation / resettlement plan takes account of these principles is assessed by Coface on a case-by-case basis, according to the scale of the relevant impacts.

The following indicators, insofar as they are coherent with the project in question, may be used to this end:

- the total investment set aside to compensate for the involuntary resettlement of populations<sup>3</sup> compared with number of persons being displaced,
  - the total value of the annual advantages for those persons affected by the project impacts compared with the number of persons being resettled.
- *Compensation for sensitive natural habitats converted or degraded by the project, in compliance with the World Bank Operational Procedure 4.04.*

Specific compensation measures depend on the ecological characteristics of the given site. They may include reintroduction of species, restoration of degraded habitats and establishment and maintenance of an ecologically similar protected area of suitable size and contiguity.

A natural habitat is considered as sensitive if:

- it is protected by national or regional legislation and regulation, or is listed as a IUCN-protected site;
- it is protected by international agreements (e.g. RAMSAR wetlands);
- it is listed as a world heritage site by UNESCO;
- it is located in a biosphere reserve listed by UNESCO, or has a vast biodiversity (primary forests, coral reefs, mangroves, etc.);
- it is a particularly important site for endangered animal or plant species on the IUCN Red List;
- it has a special significance for ethnic groups, particularly for people in the scope of the World Bank Operational Directive 4.20.

#### **Criteria No. 4: prior consultation of stakeholders in the project**

This dialogue, aimed at heightening a project's acceptability amongst local populations, must be based on principles of transparency in terms of information (as regards the Environmental Impact Assessment), where those affected are informed of any meetings on the subject and any comments put forwards are systematically answered.

For major projects, the establishment of a forum and/or working groups to which the appropriate resources are allocated is considered best practice.

#### **Criteria No. 5: safety of dams**

For dams that are 15 meters or more in height, or are between 10 and 15 meters and present special design complexities (e.g., an unusually large flood-handling requirement, location in a zone of high seismicity, or foundations that are complex and difficult to prepare), an emergency preparedness plan in compliance as defined by Annex A of the World Bank Operational Procedure 4.37 is required.

---

<sup>3</sup> Special attention is given to the way in which the cost of the land is appraised.