

Contributing Paper

Dams in Spain

Enrique Garcia
Schiller Abogados, S.C; Spain

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World Commission on Dams
5th Floor, Hycastle House
58 Loop Street
PO Box 16002
Vlaeberg, Cape Town
8018, SOUTH AFRICA
Telephone: +27 21 426 4000
Fax: +27 21 426 0036
Email: info@dams.org
<http://www.dams.org>

I INTRODUCTION

Spain has a very old tradition in Dam Construction. Even today there are two First Century Roman dams in use (Cornalbo and Proserpina). These, however, are not the only well structured dams in Spain. The Roman method of construction (which had fallen into decline during the middle ages) was reinstated, with the renaissance of dam construction during the 16th Century, precisely also in Spain where state of the art dams flourished (Alicante Dam, 1594, Tibi Dam, 1589 which with its 46 meters of height set a record not broken until the nineteenth century). But even with this tradition, the main period of construction really took place in the 1950's and 1960's, during which time the total storage capacity of Spanish dams rose from 6,000 to 37,000Hm³. (The average yearly increase from 1955 to 1970 was 2,000Hm³). Nowadays there are 133 dams (including lateral dykes) with a total storage capacity of about 54-56,000Hm³. Not only were more dams built during this twenty year period, but their water storage capacity also increased simultaneously. Today, 98% of the total capacity is stored within the 300 dams whose individual capacity is larger than 10Hm³ (only three of which Puentes and Valdeinfierno in the Segura river and Villar in the Tajo river existed at the beginning of the century).

Of the total storage capacity of around 54,000Hm³, 33,000 are public, (the State, the Autonomus Communities and the municipalities are responsible for these) and 21,000 are private (utility companies are the most numerous uniform group taking responsibility for these). Until 1950, the ratio was 50%. In the mid 60's the public dams prospered, but by the end of the 70's the private ones had matched their capacity. Only during the last two decades (especially during the 90's) has the ratio been distorted (by the end of the 70's the total storage capacity was 40,000Hm³, half of which were private, half public. By the mid-90's, the private dams increased only by 1,000Hm³, while the public ones rose from 20,000 to 30,000Hm³).

The private dams are concentrated in the North of the country (Cornisa Cantabrica, Duero and Tajo) and the public ones in the South (Guadalquivir, Sur and Segura). Those built in the Ebro (which has a little bit more private than public ones) and in Cataluña/Jucar (which has more public than private ones) have a more even ratio. The total replacement value of the dams in State hands is 2 billion pesetas (\$_____). Supply and irrigation infrastructures at another 2 billion and the works related to flood control are 0,7 billion. The fees paid to cover the regulation of the flow through dams covers only 0,2% of the cost.

II INSTITUTIONAL AND LEGAL FRAMEWORK

The management of freshwater in Spain is in the hands of either the Autonomous Communities (regional entities whose autonomy in some areas is larger than that of a state in a federation), or in the hands of broad based representative entities, the so-called Hydrographic Confederations, which are comprehensive watershed authorities. These last ones are State entities (not regional entities) which fall under the umbrella of the Directorate General of Hydraulic Works, which, on its own, is under the

supervision of the Secretary of State for Water and Coastal Management, which itself is integrated within the Ministry for the Environment.

Those watersheds or catchments areas whose whole territory is within that of the Autonomous Community are managed by them. Those other catchment areas which include the territory of more than one Autonomous Community are managed by the Hydrographic Confederations. In some exceptional cases, even if the watershed extends to the territory of two or more Autonomous Communities, particular aspects of water management (e.g. the control of the water quality of discharges) are delegated by the State to the Autonomous Communities, as it has happened in Cataluña.

The attached map illustrates the territories of the water basins (with stronger boundaries) and that of the Autonomous Communities (with light boundaries).

Water management (that is to say, the powers of either the Confederations or the Autonomous Communities) means mainly the granting and control of water rights (both of surface and underground water), the regulation and balance of all the different water uses that condition those water rights, the construction of dams (and the rest of the so-called "Hydraulic Works") and the control of water quality as well as the protection of the basin in order to ensure the quality of the water by controlling the non point sources of pollution through runoff and the erosion. Usually all these so-called "Hydraulic Works" are either directly implemented by the Autonomous Community or Hydrographic Confederations (when they are public) or authorised and monitored by them (when they they are private).

It is important to understand the meaning of "Hydraulic Works" since there is no specific regulation on the administrative authority and contracts which are the base for dam construction and supervision. Dam construction and follow through is regulated by the more generical legislation on "Hydraulic Works", with some exceptions, dealing with safety and environmental impact assessment, which will be analysed later. "Hydraulic Works" include dams ("presas"), small dams to capture small amounts of water or to divert small flows ("azudes"), systems to capture underground water, channels and pipes for water supply for industrial or urban uses, irrigation channels and pipes, drainage and irrigation water recapture systems, service roads and trails, drinking water pre-treatments plants, waste water treatment plants, waste water reutilization plants, desalinisation plants, hydroelectric plants, transportation and navigation works, hydrologic-forestry works, fish ladders, and water flow channelling as well as flood protection works.

There is no specific regulation of all these hydraulic works either, notwithstanding their importance. One must apply the general laws governing all public works, an old Act of since 1911, mostly obsolete, whose main principal is the need to have the each of the works appropriated by the yearly Budget Act as well as approved by another different substantive Act passed through Parliament that either authorizes a list of works included in aplan or program, a single work or a list of them under no plan.

Regarding the construction (and, if it were the case, the management of the service for which the construction is done, such as water supply, electricity production if of public origin...), the law applicable is the Public Procurement Act or Public Contracts Act 13/1995. Both the Act of 1911 and the 13/1995 Act need to be construed in accordance with the Water Act of August 2nd 1985. This one, which should have rationalised the whole system and regulated the hydraulic works in a comprehensive way, has very few articles addressing them. The only important reference made to them is Article 44, which literally states that "the public works of hydraulic nature that are considered to be of general interest or that affect more than one autonomous community shall be approved by an Act of Parliament and should be included in the National Hydrologic plan". It is true, however, that many other Articles of the Water Act of 1985 that introduce refinements on the procedures to grant water rights (urban or industrial supply, irrigation, hydroelectricity ...etc) or that limit them (minimum waterflows, wetland preservation....etc) have a direct impact on the way in which hydraulic works, and, thus, dams, should be carried out.

It is also true that there are many other Acts that may have an impact on the way in which these works are planned and developed. Among them, the most important, of course, is the need to conduct an environmental impact study or an environmental impact assessment (EIA). Actually, the Water Act only imposes environmental impact studies in Article 90 (there is no need for public participation nor for an official environmental impact statement conditioning the work) for most of the authorisations or grants of water rights that may affect the public domain (all waters are considered in Spain to be public domain) and may imply risks for the environment. Nevertheless, the enactment, one year later, of the Environmental Impact Assessment Act and its Regulation (the Act is from 1986 and its Regulation from 1988), which implied the implementation in Spain of the Environmental Impact Assessment Directive 85/337 of the European Union, specified very clearly what are the procedures applicable for the construction and other hydraulic works, listing them in Annex 1 and Annex 2. Annex 1 of both the Directive and the Spanish Act include the "Great Dams" as works that necessarily are submitted to the full environmental impact assessment procedure. This concept of Great Dam has been defined by the Spanish EIA Act and Regulation as those that have more than fifteen metres of height (55 feet), calculated as the difference between the crowning of the dam and the lowest point in the general surface of the base of concrete. Or, also, those dams that have in between 10 and 15 metres of height may be included if they fall within one of the following categories: 1)

Storage capacity bigger than 100,000 cubic meters; 2) exceptional characteristics of the cementation; or 3) any other circumstance that may allow to label the work as important for the public security or economy (this definition of Great Dam for the sake of determining which dams are mandatorily submitted to EIA was taken from the definition of Great Dam under the safety Instruction of 1967 about which we will comment later).

Spain, up to this moment, has not complied with the European Commission's interpretation that it should go beyond Annex 1, in order to include works of Annex 2 in the list of those that need to be submitted to environmental impact assessment. As it is well known, Annex 2 of the Directive establishes categories in broad terms that the

member States of the European Union, need to consider in order establish thresholds that would determine which, among those broadly described works, must be submitted to environmental assessment and which do not. Annex 2 of the Directive simply says that the works of channelling and the regularisation of water flows and dams and other works destined to contain or store waters in a permanent way are included in Annex 2, so that means that Spain should establish some threshold determining which, beyond the great dams of Annex 1, should also be submitted to environmental impact assessment. As just mentioned, this is not the case, and legislation is pending because the European Commission has taken Spain to the European Court of Justice for the non implementation of this Annex 2. Thus, at least for the great dams, which are the main object of this report, it is true that the EIA Act and Regulation are applicable and are allowed to condition the construction not only to safety but also to mitigation of the future impacts related with the social economic as well as ecological environment in which the dam is built.

Returning to the way in which hydraulic works are treated by the general legislation, the need to treat them from a comprehensive point of view caught such a momentum (see the White Paper on water in Spain, under draft by the Ministry of the Environment) that the Government introduced an amendment of the Water Act of 1985 that the Parliament has just approved in December 13th 1999. The new Act has introduced a new Title VIII to the Water Act, which includes seven articles. The first one (Article 114 of the Water Act), defines what is to be understood by hydraulic works, in terms very similar to the ones previously stated in this report; the second (Article 115) describes the way in which they should be conducted depending on whether they are public or private, including in the first category those that are directly administered by the Public Administrations and that are destined to warranty protection, control and supply of fresh water and the use of the public domain. It allows the Public Administration to sign compacts for the making and financing of those works, with those who are going to be benefiting from them directly, as well as to delegate to the users, organised in public associations or similar institutions, the exploitation and maintenance of those hydraulic works that are built or in place mainly for their benefit.

The third one (Article 116) is especially destined to introduce in this area a legal development that has already taken place in relation to all the public works such as airports, highways and harbours, consisting in the need not to submit the project to the necessary licensing of the municipality where it takes place (previously all public works need such a license, although in special cases the government could oblige the municipalities to issue the license by obliging them, and directly to change the special and zoning plan in force). Of these three Articles, emphasis should be placed in the second one because it allows for the use of private law mechanisms and contracts in order to ensure the capitalisation of the construction and maintenance of the dams, simply by negotiation of the incorporation of the capital of the future users of the water as part of the investment capital needed for the construction, as well as other mechanisms such as special fees that would, later on, provide for the financing in the medium or long term of the part of the investment, than by the State. This new financial mechanism is completed with the creation of State owned corporations which run the whole operation and that were already in place in several basins starting to

operate two years ago.

The rest of the articles (117 to 120) introduced other minor regulatory aspects.

All these general laws governing hydraulic works and which are applicable to dam construction and management are supplemented with a set of technical regulations, either general or use oriented.

Among the second are the laws governing the electricity and energy markets as well as the very low level regulations, which regulate the content of water rights, whenever they have as their main destiny the production of electricity.

Among the first ones are the regulations specifically authorising dam construction. They are the Instruction on the Design, Construction of Management of Great Dams (approved by Ministerial Order of March 31st, 1967) and the regulation that substituted it later, the so-called Technical Regulation on Dam Safety (approved by Ministerial Order of March 12th, 1996). The substitution of the Instruction by the later Regulation has not been completed. Due to the complexity of the new Regulation, the abrogation of the Instruction was delayed so that, on a first phase, the Regulation is applicable only to dams under the management of the Ministry for the Environment, as well as to those private ones directly under the supervision of the Ministry (because the State may have been the one to award the water right). Thus, there are dams whose safety is still governed by the Instruction and others whose safety is nowadays governed by the Regulation of 1996. We will return to this regulations later, when dealing with the safety mechanisms in the medium or long term life of a dam.

Finally, there is no Scenic Rivers legislation in Spain so limitations to dam construction based on visual or cultural impacts are out of consideration.

III CONSERVATION, MAINTENANCE AND MODERNISATION OF DAMS

The conservation costs of dams are quite high (usually 0.5% of the total investment costs) and the institutions in charge, usually the Hydrographic Confederations, have budgetary appropriations but normally they have to contract additional external services to provide for the task due to the lack of material and human resources. In any event it is part of their yearly budget. Usually the life of the dam is longer that what the legislation takes into account in order to make the estimate of depreciation costs (50 years for those that imply general waterflow regulation -a concept later discussed- and 25 for the rest). Thus, in most of them, the depreciation fee does not include the financing of the replacement costs of the infrastructure. The exception is the cost of technological changes, such as electromechanical equipment, which usually is repalced when needed by allocating its direct cost in the yearly budget.

Neither the Water Act, nor the rest of the legislation provides for the modernisation of dams, nor for its financing, although it is seen as one of the areas where high investments will be needed in the near future. Neither does the legislation provide for the decommissioning of dams. The only idea more or less similar to that is Article 282 of the Regulation that further develops the Water Act of 1985 (the regulation of Hydraulic Public Domain of 1986). This Regulation, when addressing the issue of wetland management, which states that whenever the benefit initially estimated for an irrigation scheme is not reached, the Government might declare mandatory the restoration of the wetland. By the way, the previous Article (Article 281), in the second paragraph, also establishes that "whenever a new dam is built a study will be done about the opportunity to do the necessary adaptation of its head or borders in order to establish the precise conditions which may allow them to function as wetlands, in or, particularly, to be used as habitat of biological communities".

It is however also true that the Technical Regulation on Safety of 1996 also addresses issues related to the refurbishment, modernisation and decommissioning of dams, as we will immediately see.

IV REGULATIONS ON THE SAFETY OF DAMS

As mentioned before, there are at this moment two different regulations applicable to great dams. The Instruction of 1967 and the Technical Regulation of 1996. Both of these were prepared by the National Commission for Great Dams, a consultative body created by Spain in 1959 and established as a permanent body in 1965. The Instruction is exclusively technical and focuses on the safety requirements on the design and construction, as well as on the rules for the follow through of the safety perimeters, during the exploitation of the dam (maintenance of records and registration of different data that, if analysed or inspected, would allow a quick judgement on the safety of the dam). It does not incorporate amongst these requirements any procedure to reassess the objectives of the dams. It only prescribes how to proceed in cases of emergency, by authorising the engineering charge to adopt any interim measure that may not be delayed, such as emptying or refurbishing the dam (any other emergency measure must be notified to the Directorate General of Hydraulic Works).

The only aspects related to anything beyond the refurbishing of the dam, are those described as general principles applicable to the design in Article 6 and which do not have any further consequence. There are no special procedures to ensure their implementation. What is more, the instruction does not say exactly how to assess whether the dam, during its life, is separating itself from the objectives, the analysis of which is a requirement for the design and commissioning of the dam.

These general principles applicable to the design and construction of the dam are the following:

- a) To pursue the safety of the works against any contingency of important damages, although unnecessary costs must be prevented.

- b) To prove, through a technical study, that the projected dam can be co-ordinated with the integrated management of the river, so that the latter is not conditioned by the former.
- c) To provide for the use of the dam so that all the natural resources, or those other resources created by the dam, may contribute to increase the national wealth, notwithstanding their secondary character in relation to the main objective of the dam, whenever these can be achieved without a sensible impact on the latter.
- d) To care about the visual impact of the work and machinery on the landscape and to profit, within the legal limitations, from the possibilities of recreational, touristic and sport uses, as soon as these last ones do not distort the projected functionality of the dam (...).

Thus, besides the absence of procedural mechanisms to impose the real implementation of these principles on their own terms, all other considerations different from the absolute priority of the dam, once its construction is decided, are considered secondary.

Although the Instruction does not define when nor how it is to be decided, it foresees the consequences of the decommissioning of dams establishing, in Article 100, that "whenever it might become necessary to abandon or to demolish a dam, the Directorate General of Hydraulic Works, shall approve the official plan to leave the river in such manner that it will not imply any danger downstream. In no case will the Public Administration allow the abandonment of a dam, without taking the appropriate measures in order to warranty the safety of the zone". In brief, there is no real methodology to evaluate the financial balance or the socio-economic or environmental data submitted at the beginning in the design phase of the dam, for the sake of determining later the possible refurbishment, redesign, modernisation, reoperation, modification or decommissioning of dams, beyond the strict technical failure and the technical safety parameters that are measured and registered. Faulty design and technical breakdowns are the only failures which those parameters measure.

The Technical Regulation of 1996 pretends to be more complete, since, as its preamble states, it does not focus on the technical solutions required for the design, construction, exploitation or decommissioning of the dam, but rather on the broadening of the scope (1) of the safety criteria that must be taken into consideration, including socioeconomic and environmental impacts of the dam, and (2) of the phases of the life of the dam, including all of them from the design to the decommissioning. The preamble of the Technical Regulation explicitly recognises that there was a gap on the previous legislation regarding these aspects.

The result, nevertheless, is very similar to that of the Instruction, although it focuses on procedures in order to highlight risky situations, rather than on the specific technical solution to those problems encountered. Once more, the only risks considered are

those of the rupture of the dam (earthquakes, faulty design, faulty materials, exceptional avenues from excessive storm runoffs reaching the dam, hydrostatic pressure, overstorage... etc.) and the measures to be adopted do not go beyond the refurbishing or technical modification of the dam, or in an extreme case, its decommissioning.

The main difference with the Instruction, besides leaving the technical solutions to the managing authority, consist (1) in the increase of the number of dams included within the scope of the Regulation (the notion of great dam is broadened) (2) in the need to categorise (A, B or C) the dams depending on the degree of environmental and property damage that its malfunctioning or rupturing may cause, (3) on the need for those dams of category A, to put in place an emergency plan coordinated with the plans of the Civil Protection Authorities; (4) on the more specific parameters that need to be registered and the definition of activities that need to be put in place, depending on the different better defined phases on the life of a dam (design, construction, commissioning, exploitation and decommissioning).

The Technical Regulation does not provide at all either for modifications of refurbishments related to topics different from safety.

Once more, although the abandonment or decommissioning is foreseen by the regulation, it is only in order to ensure that there is a plan providing for the safety of the abandoned infrastructure.

The better accuracy in the definition of the parameters affected by the dam, has as a result the need to produce better studies in the design phase (Article 26.5). Thus, the Technical Regulation makes mandatory, for example, the production of studies on the objectives of the dam and its functions within the complete scheme of integrated uses of water in the basin; on the impact on human settlements; on the quality of water (eutrophication and stratification included); on erosion, sedimentation, and suspended solids flow; on the socioeconomic impact and its protection (...); and on the impact on landmark and historic sites and their management, and on the need of a programme of environmental supervision.

As it happened in the Instruction, the results of these studies do not entail any specific consequence, neither for the project itself, nor for the establishment of any decision making procedure in order to review or at least to reanalyse the necessity of reordering its objectives or even of the dam itself. Once those studies are done and the design is completed and the dam constructed, no single procedural mechanism (not even formal ones such as the registration and inscription in data in the official records), is in place to compare the functions of the dam as it starts to live with what was originally assessed as the dam's objectives.

Finally, although the Technical Regulation changes the notion of great dams, it explicitly maintains the former definition of great dams that we have already seen for the sake of determining which dams are mandatorily submitted to environmental impact

assessment.

AV A BRIEF NOTE ON THE REAL EFFECT OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURE.

The Spanish Act of 1986 and its Regulation of 1988 provide for mechanisms in order to impose socio-economic and environmental conditioning on dams (even the abandonment of the project itself, if the environmental cost benefit analysis is excessively negative).

The European Union Habitats Directive 43/1992 and its implementing Spanish Regulation (approved by Royal Decree 1997/1995) have been especially effective in giving content to this environmental impact assessment procedure, since they both condition the commissioning of dams to the maintenance of the ecological functionality of the place in such way that it needs to ensure the preservation of the favorable status of conservation of the ecosystems and species of European interest that have been the cause for the listing of the place as Bird Specially Protected Area or as Site of Community Interest, both of which will be forming part of the future Natura 2000 Network (16% of the Spanish territory).

In the case of Spain the Habitats Directive and the 1997/1995 Regulation have also conditioned the use of the Cohesion Fund and other European Union Structural Funds. All the dams designed for construction after 1994, are financed by this European Union Structural Fund, so the environmental impact assessment procedure and Habitats Directive have been effective in restricting possible excesses on the design or construction of the dams. Some cases where the European Commission has been specially stringent in controlling the funding are, for example, the cases of the dams of Melonares and La Breña II in Andalucía and Iruña in Castilla-León.

In other cases the Habitats Directive has been used not so much to prevent funding of dams that do not seem to respect their provisions, but directly to challenge their commissioning before the European Commission and the Spanish Courts for breaching EU law. The most well known case is the Itoiz dam in Navarre, that, although already built, cannot be filled because if it reaches its designed level, it may flood a Bird Specially Protected Area. The judicial order to stay is an interim measure pending final decision of the Spanish Highest Court. But, in general, the environmental impact assessment is a procedure that can impose mechanisms of conditioning and follow through that are assessed at the initial moment in the design phase of the dam. At the most, it can ensure the implementation of those conditions, but it is not a procedure that allows for a reassessment of the environmental and socioeconomic consequences neither of the fulfillment of the original objectives as soon as the life of the dam starts to run after being commissioned.

The environmental impact assessment is not a procedure devised as a mechanism to trigger changes based on unforeseen circumstances. It is, thus, a very good and effective tool

in the design and construction phase, but a completely useless procedure if one pretends with it to take into account decisions to reanalyse the objectives of the dam, once the project is approved.

VI CONCLUSIONS ON DAM SAFETY

The refurbishing, modification and decommissioning of dams is foreseen and very clearly regulated when they might be based on safety concerns (and although not mentioned in the regulations, one can imagine that decisions to modernise and re-operate the dams based on these safety features are also covered by the regulations). The safety issue and all its possible causes are well taken care of in the Spanish system. It is true, nevertheless, that the financial and human resources to implement the Instruction and the Technical Regulation are not entirely in place. The draft of the White Paper on Water in Spain, recognises that the time delays foreseen in the Technical Regulation in order to have all the dams to which it is applicable adapted to its terms, have not been met. One year to have the dam officially classified as A, B or C category and three to six years to have the first comprehensive inspection and review of the safety conditions. In 1999, three years later, 70% of the State owned dams (around 300) have been classified, the rest have submitted the proposal. On the private side (around 130 hydroelectric, around 700 for other uses) compliance with the Technical Resolution is taking more time.

Actually, the record of Spanish Dam safety is quite high. Since the time of Philip II, where there was a disaster, only in 1957 (Rivadelago dam in Zamora, Castille-Leon) and 1982 (Tous dam in the Jucar River) have there been dam ruptures. Other cases have had minor consequences; they were mainly ruptures of provisional dykes, built to divert the water and river while the dam construction was taking place.

The Tous dam case on its own is worthy of a case study, since all the activities and actions (from the design, to the events that took place, to the new dam built where the ruptured one was) are very well documented because of the litigation due to personal and property damage caused by the floods that ensued. The way in which the new dam has been built, fortunately, could be showed as a very good example of how things should be always done.

VII MEASURES ADOPTED DUE TO OTHER CAUSES

Since the financial mechanisms that provide for the uses of water are clearly insufficient to finance the conservation and maintenance of the dams (see section III), and since there is no really binding (not even politically conditioning) cost-benefit analysis of the projects, there are no mechanisms in place in order to provide for the modernisation, reoperation or decommissioning of dams, based on their economic imbalance due to unforeseen or miscalculated circumstances.

For example, one of the most contested dams in Spanish history is the Riano dam in the province of Leon, due to the natural beauty and values of the flooded valleys, as well as that of the main town that disappeared. It is also true that it took so long from the design and commissioning phase and the payment of compensation for the condemned property to the actual building of the dam and storing of the water, that, by the time in which they took place, the local communities had completely changed their minds. Notwithstanding the violence and public disorder the dam was put into service. But it has never reached the level of the expectations (mainly irrigation) that was the original objective for its commissioning since the farming communities are much fewer than those originally estimated. Nobody is, anyhow, thinking in anything that would remotely look similar to decommissioning and the cost of restoration of the natural ecosystems already flooded would be immense.

In some other cases there are "accusations", mainly by the NGO communities (although some municipalities eventually adhere to their positions) in the sense that the existence and amount of potential users estimated for the commissioning of the dam are artificially construed in order to justify the positive cost-benefit analysis thus protecting interests that would not render the dam economically viable. One dam under design -the Janovas dam in Northern Aragon (presently possibly the most conflictive one, with that of Itoiz, in Navarre, and Melonares, water supply for Seville) - is being opposed under such type of allegations. In any event, the new trend of liberization, through the previously described State corporations and compacts with the users system, make the possibility of such flaws in the system much more difficult.

There is, however, a policy concept that counteracts and mitigates this frustrating lack of procedures that may control the socioeconomic and environmental efficiency of the dams in the medium and long term. It is the so-called "regulation-dam concept". "Regulation-dams" (in Spanish "embalses de regulacion") are those that have as their main objective to flexibilize, on a year by year basis, the distribution of water to the different water users downstream. Usually in any given basin, there are three or more multipurpose dams that store the water in order to allow for the most rational distribution of water during the part of the year when there is always a water shortage (Spain, as most Mediterranean Countries, has a hydraulic cycle characterised by their extreme droughts during the summer and for its extreme droughts all year long, for periods of five year cycles). The main objective of these dams is their "multiuse" or "multipurposes" redistributinal function. This "regulation" character is attributed to the different dams usually in the Plan of each basin. Some dams have this "regulation" attribute given by macroschemes of regional economic planning (that is the case, for example, of all the dams of Extremadura under the Plan Badajoz).

Another very important feature of Spanish dams is their function as storage dams for interbasin transfers of water ("trasvases" in Spanish). In Spain there is an excess of water in the North/Northwest, while in the South/South East, water is seasonally (or yearly in the drought cycles) a very scarce resource. Special Hydraulic Works provide

for these transfers, which have not only a special administrative regulatory scheme, but also a financial mechanism to compensate for the loss of water from the basins from which it is taken. In some cases conflicts arise when the water is taken from basins where water is not so clearly in excess (particularly in the transfers from the Tajo River to the Segura River). In these cases the "regulation" notion goes beyond that of the integrated management of the catchment area.

The financial and economic miscalculations appear more easily in the private dams, since the fees for water rights might make non-profitable the investment. Under the Water Act of 1985, all water rights last only 75 years and must be in actual use three years after their award. There is no historical record at the Directorate General of Hydraulic Works on any case on which the grant was revoked because the stored water was used for a different objective. Neither has there been any case where the grantee has asked for a review of the fees, arguing the financial balance on which they were based was enormous, rendering the grant non-profitable.

It is true nevertheless, that there is a certain assumption that many grants are purely nominal and that the grantees have not invested in the needed work, because they think that there will not be enough returns. The absence of sufficient human resources has prevented the Directorate General from screening how many grants might be in this illegal situation of non compliance with the obligation of the grantees to have all the infrastructure in place in the first three years of the award (this three year time limit to start water consumption, that is to say, to have the infrastructure in place, is new under the 1985 Water Act, although the Act is applicable to all grants: to those previously existing and to the new ones).

There are also examples in which previously granted rights have had to modify their content in order to meet environmental considerations. The most important case is the Sela Dam, in the Mino River, at a zone in North Western Spain, where its waters are shared with Portugal. The Great Dam Project will probably have to be abandoned and substituted by a group of small dams although the environmental impact assessment procedure at both sides of the border has not yet finished.

Sedimentation is a very import problem in some Spanish basins. The designers of dams, although aware of the problem, are not providing for solutions. In a test study conducted by other Governmental units, the following data showed very clearly the amount and level of erosion and its impact on the estimated storage capacity in all the Spanish basins.

Table.

Basin	Number of Studied Dams	Total initial Storage Capacity (hm3)	Total final Storage Capacity (hm3)	Loss of Storage Capacity (hm3)	Loss of Storage Capacity (% of initial volume)	Average period of time (years)	Yearly average loss of Storage Capacity (% of initial volume)
Norte I	6	17	499	18	3	31	0,11
Norte II	3	314	256	58	18	33	0,56
Norte III	2	64	62	2	3	36	0,10
Duero	5	899	875	24	3	34	0,08
Tajo	12	3.970	3.892	77	2	28	0,07
Guadiana I	5	2.082	1.932	150	7	29	0,25
Guadiana II	0	--	--	--	--	--	--
Guadalquivir	22	3.706	3.581	124	3	28	0,12
Sur	6	558	544	15	3	24	0,11
Segura	12	951	855	95	10	49	0,20
Júcar	16	1.474	1.420	55	4	30	0,12
Ebro	17	3.075	2.805	271	9	35	0,25
C.I. Cataluña	4	211	199	12	6	36	0,16
Galicia Costa	0	--	--	--	--	--	--
Total	110	17.321	16.921	901	5	31	0,16

The only existing mechanism to prevent the sedimentation, about which Spain has a very developed technology (the so called "forestry hydrology"), is intentionally disconnected from the management of the dams by the water authorities. The projects of forestry hydrology are administered by the Autonomous Communities and the Directorate General for Nature Conservation, whose planning is not even informed by the Hydrographic Confederations or the water authorities of the Autonomous Communities, because its budget is totally independent and the human resources in charge (forestry engineers) have been traditionally totally discoordinated from the works that are designed and conducted by other professionals (civil engineers). The recently approved National Forestry Strategy (it was approved by the Ministerial Conference for the Environment, which includes the State and Autonomous Communities' ministers, on March 8th, 1999) provides for the need of a coordinated action in this sphere for the 21st century. But it is a result that will be difficult to achieve because it implies a huge amount of cultural and professional perception changes.

Presently, the National Programme on Forestry Hydrology is disconnected from its impact on dams and the projects approved are based on many other factors, different from the sedimentation that they might produce on them. The Ministry of Finance has considered (in conjunction with the European Commission) that preventing erosion is not an important environmental matter and has discontinued the financing of these programmes through the European Union's Structural Funds (especially the Cohesion Fund which until 1997 was used in order to prevent this erosion in many basins but that was closed to these activities after that year). Remediation of sedimentation is done through the dredging of the base of the dam in the most severe cases. Dredging operations have taken place, for example, in some dams of the Pyrenees and in the East/ South East (Puentes dam in Lorca or Elche dam in Alicante).

Sedimentation is an issue which the private hydroelectrical dams do not care much about, since the plants obtain the same pressure as soon as the upper layers of water can be channelled towards the pressure pipe penstocks. The supervising authorities sometimes have problems in making dam managers open the base spillway that usually allows for reasonable amounts of silt to follow the water flow. In some cases, nevertheless, the sedimentation has been so important that the hydroelectrical use of the dam has been abandoned. The most clear example is the Castrejon dam, near Talavera de la Reina, where the utility company (Union Fenosa) has installed a photovoltaic energy production unit, whose electricity is distributed from the same plant that formerly distributed the hydroelectricity from the dam. The dam remains as a typical non-deep wetland and has natural value as a bird reserve.

VIII A SPECIAL ISSUES: FISH LADDERS AND MINIMUM INSTREAM FLOWS

Due to the existence in Spain of quite a few anadromous, catadromous, anfidromous and potamodromous fish species, the legislation of the Autonomous Communities on

fluvial ecosystems, usually makes mandatory the construction of fish ladders or fish passes in the dykes and dams. The application of this legislation to existing dams is not usually mandatory (it is applicable only to new dykes and dams). A recent research conducted by the Directorate General for Nature Conservation (Impacto de las Obras Hidraulicas en la Ictiofauna : Dispositivos de Pasos para Peces en las Presas de España, Benigo Elvira, Graciela Nicola and Ana Almodovar) has analysed and evaluated the existing passes. While their present location (they are usually constructed in the river where those species exist; 90.5% are located in rivers with salmonides), their status of conservation (58.3% are in very good shape), and their efficiency (56.3% are categorised as very permeable to fish passing) are very satisfactory, most of the great dams do not have them. Even if they do, the passes are inefficient since the system normally used (successive pools) is not permeable to the fish population when the dam is higher than 30 metres.

Another special issue is the consideration of minimum water flows. There has been a long legal fight about who is entitled to set them, whether the Water Authorities or the Nature Conservation Authorities (which also meant State versus Autonomous Communities since the Hydrologic Confederations are State run authorities while the nature conservation management is mainly on regional hands). The Constitutional Court finally decided in early 1999 that the imposition of minimum flows should be considered water management. Thus, many regional Acts establishing special ecological waterflows are void. The State practice on minimum waterflows, when conditioning the granting of water rights, varies with each basin. The White Paper on Water in Spain, on draft, emphasizes the need to build consensus around specifically validated methods of calculation of ecological waterflows (there are more than five different ones now being enforced).

In any event, the implementation of legislation on minimum waterflows thus affected only new infrastructures and never existing ones although, through negotiated settlements, the Autonomous Communities tend to convince the owners of those infrastructures to respect minimum flows whenever the modifications required can be achieved at a low cost.

IX. SUMMARY ADAPTED TO THE TERMS OF REFERENCE

1) Factors affecting safety and functioning after the dams are commissioned.

In Spain the faulty design does not usually occur. There have been only three major disasters since the 15th Century.

Sedimentation is a very important problem (Puente or Elche dams in the East and almost all the dams of the territory of the South Confederation). Faulty environmental impact statements, specially in areas of biodiversity, protected by the Birds and Habitats European Union Directive, eventually may affect or delay the final commissioning of some dams (Melonares, La Breña II, Itoiz..).

Lack of economic probability is not considered in public dams and has affected the delay of the building of infrastructure in the case of private dams, although this last situation has not yet been evaluated. The only disaster that has recently taken place (Tous) was due to faulty calculations of the spillway capacity when dealing with strong storm runoffs.

Eutrophication is a real problem in many dams. Although there are provisions on wetland restoration in the Water Act when irrigation projects fail, they are not implemented even when expectations are not clearly met. (Riano).

2) Information production and timing in order to monitor the effects.

The Spanish system is very detailed and provides for a well timed procedure for issues related with safety.

The environmental impact assessment of great dams prevents effects ascertained and taken into consideration in the design phase. There is no follow through procedure, much less a decision making one, to redress negative impacts in order to reoperate or decommission dams due to new circumstances, different from safety, that may show up during the later life of the dam.

The legislation has mandatory technical rules on design that focuses explicitly on wetland preservation and artificial creation at the head and the riversides of the stored water. It is also reasonably good on fish ladders and passes although not in the case of great dams.

3) Policy and good practices

- There are very well established for safety purposes (Instruction of 1967, Technical Regulation of 1996). There is a reasonably well operating control for other objectives under the environmental impact assessment procedure.
- There are absolutely no controlling data, or no consequence can ever stem from the data, on the lack of socioeconomic, or even purely physical physical (sedimentation, eutrophication...) environmental benefits (Riano, dams within the scope of the Confederation of the South), with some exceptions (Puente, Elche).
- There is no Scenic Rivers legislation. Limits to dam construction based on visual and cultural impacts are non-existent in Spain.

4) Decisions made on refurbishing, modernisation, reoperation or decommissioning

Before final commissioning the Instruction, the Technical Regulation and the EIA procedure ensure the capacity to take into account most socioeconomic and environmental considerations (Sela, Itoiz -although through EIA judicial enforcement-, La Brena II, Melonares..).

Although there have been cases of decommissioning, for reasons different from safety (Castrejon), reordering or decommissioning is "hidden" by private grantees of water rights (who also have to build the dam) in order not to lose those rights. There have been no such cases with public dams. The legislation introduced in Parliament (amendments to the Water Act) and the new infrastructure building through social compacts and State corporations may imply better market controls (real user payment) which at the same time, will need reassertion of non-market values at risk (social and environmental risks).

5) Financial and economic agents

Monitoring and maintenance are not covered by the normal fees system. The draft White Paper on Water in Spain signals the need for reform in this area. The public budget of the Hydrologic Confederations is supposed to cover everything. There is not enough financial nor human resources to monitor the safety in a totally efficient manner, much less to cover the assessment of other considerations (and even much less to take decisions reconsidering the objectives nor how they can be financed).

Decommissioning is foreseen as a possibility under the Hydraulic Domain Regulation for wetland restoration purposes and also, without definition of motives or causes, by the Instruction and the Technical Regulation on Dam Safety. In this latter case, rather than stating that decommissioning is foreseen as a possibility, what is foreseen and regulated are the safety issues of the consequences of decommissioning.

There are cases of decommissioning and/or modification before design or before construction (Sela) and cases of delay of the commissioning for lack of profitability of the water rights.

There are no cases of decommissioning (to be statistically assessed by the water authorities) for fish passing purposes, since the fish ladders and passes seem to be working reasonably efficiently where they exist and applicable only to new dams. The technology does not seem able to work efficiently in dams higher than 30 meters.

6) Economic, social and environmental effects of decommissioning and technical issues surrounding dam removal

As stated in the previous point, there are no cases of "legal" decommissioning, so there are no precedents about the effects. The Instruction and Technical

Regulation on Dam Safety include very precise provisions on the safety requirements of decommissioning.

7) Recommendations and Guidelines

- The safety regulatory process in Spain can probably be used as a model.
- Concerning all other considerations any guideline ensuring procedures to reassess the achievement of the objectives stated at the design phase and in the environmental impact assessment procedures, should be welcome.
- Specific statutory mandates of wetland preservation and artificial wetland creation when designing and building dams, probably prevents one of the most environmentally damaging effects of dams (wetland territory disappearance) and can be achieved with a minimal cost.