

FRAMEWORK FOR POLICY AND DECISION MAKING ON DAM AND HYDRO PLANT REHABILITATION & UPRATING

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Abstract:

Many dams and hydro plants that will be operating in the 21st century already exist. Improving performance and optimising benefits of existing assets is envisioned as a significant contribution towards sustainable development by a large panel of institutions, including the World Bank, the International Energy Agency and the International Hydropower Association.

The setting up of a “Framework for Policy and Decision Making on Dams and Hydro plant Rehabilitation and Uprating (R&U)” has two main objectives:

- Promoting rehabilitation and uprating for improving dams and associated plant performances by identifying additional benefits and new financing sources; and
- Developing a framework document that can be used for the preparation of rehabilitation and uprating projects, with particular focus on developing countries.

The framework report will support decision-making that includes needs assessment and policy formulation, strategic level assessment of R&U potentials, and identifying likely incentive-measures for encouraging R&U. The potential for a prompt implementation of the project outputs exist in many borrowing countries most notably in the Former Soviet Union countries where the quantity of assets (dams, hydro power plants, irrigation schemes, etc.) is relatively much higher than in other countries with a comparable per capita GDP.

Keywords: Rehabilitation, Uprating, Dam Safety, Optimisation, Benefits, Stakeholders, Dam, Hydropower plant, Policy, Decision making, Social, Environmental, Financing.

1 Why a specific approach for R&U ?

Dams and hydro plants are long-term investments that can benefit several generations. They have very low operating costs, and once the initial investment has been repaid, say after 10 to 20 years, they constitute a resource, which can deliver financial, economic, environmental and social benefits for several generations, typically over 100 years. Dams and hydro plants are thus key tools for sustainable development and have a major role to play in the water and energy nexus.

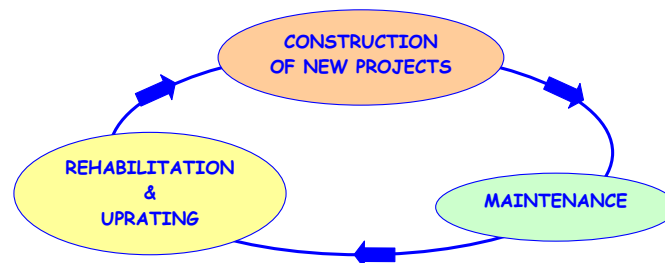


Figure 1: Overall cycle for hydropower project

Obviously R&U, as an endeavour to get the most out of existing assets, can contribute efficiently to a sustainable use of water resources. However, a number of other events and activities also occur during the life of the facilities, and it appears worthwhile to specify and position R&U better in the overall cycle (see Figure 1). In the following, R&U includes Rehabilitation, Uprating, Dam Safety, Optimisation.

Proper maintenance is central to ensuring the smooth performance of existing structures and equipment on a day-to-day basis. But it cannot fully eliminate the aging process, which makes it necessary at some point to undertake a rehabilitation project in order to avoid both the reduction in revenues and the increase in operation and maintenance costs (see Figure 2).

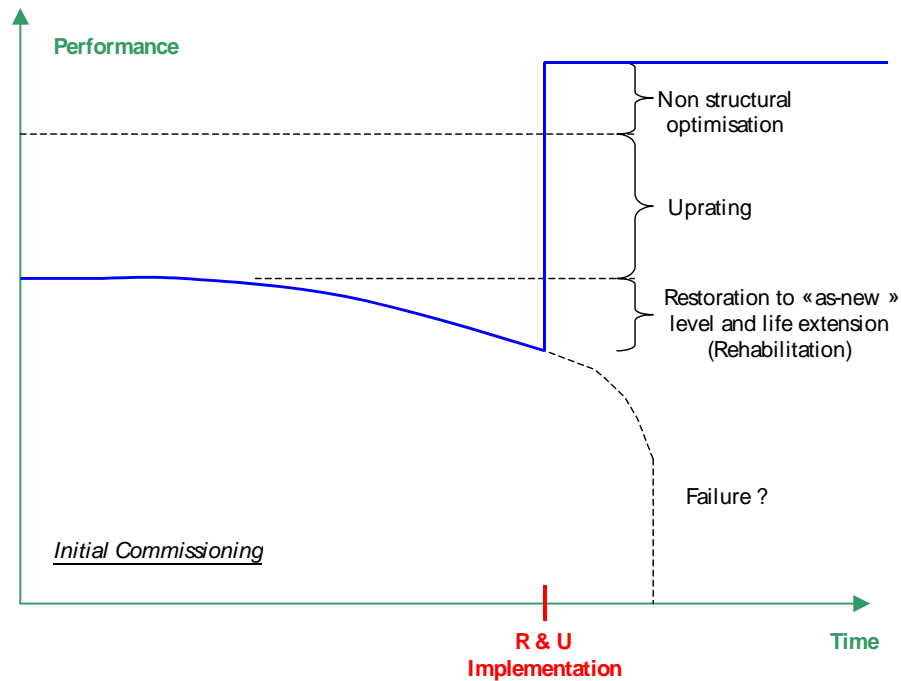


Figure 2: Evolution of the performance of an asset through time

R&U has major differences with Maintenance and New projects as shown below:

R&U versus Maintenance	R&U versus New projects
<p>R&U :</p> <ul style="list-style-type: none"> • Requires specific decision-making and funding (project approach), • Increases asset value, • Is usually not carried out by those responsible for O&M. 	<p>R&U :</p> <ul style="list-style-type: none"> • Does not stem only from Power or Water Development Plans (but also from bottom up), • Lower risk exposure profile (Hydrology, geology, ...) • Benefits and costs require a more in-depth analysis, • Social and Environmental issues are usually less sensitive

A risk exists that R&U may fall in the gap between Maintenance and New projects and may not be properly considered in the assessment of the various options available for meeting the growing water and energy needs.

These reasons have led the World Bank to develop a specific approach to foster implementation of R&U projects in countries or regions.

2 What is the potential ?

The potential for rehabilitation of hydro plants has been growing for the last 10 years as demonstrated by R&U orders registered worldwide (see Figure 3). North-America and Europe presently represent near 70% of the market shares and will remain a major contributor in the next decade since most of hydropower plants in these countries were built in the 50-80's.

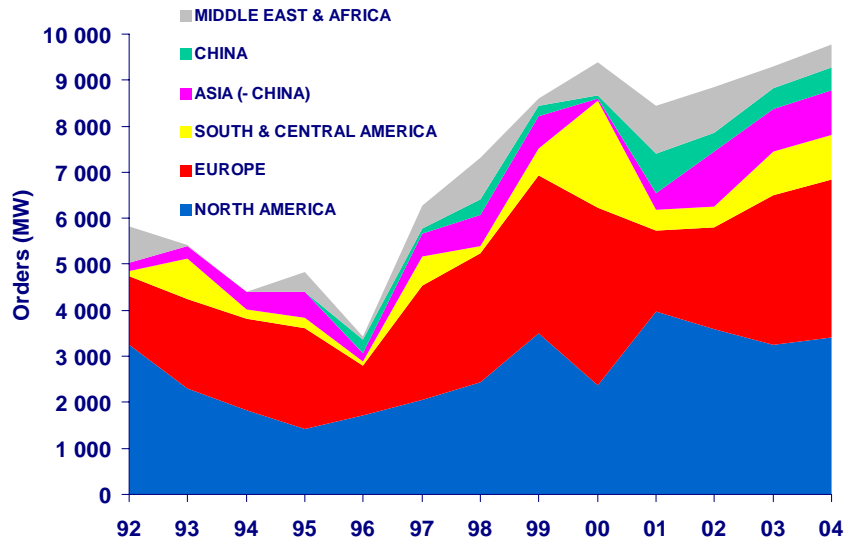


Figure 3: Worldwide orders in R&U projects over the last 10 years (HEA source)

Regarding electromechanical equipment, HEA (The Hydro Equipment Association) considers an average cost of 100 US\$/kW. In 2004, the total order for R&U programme is approximately 10000MW and is representing a 1 bUS\$ investment.

Within this general trend, some countries such as India have been identified as having a high potential for R&U. The first rehabilitation programme in India was carried out between 1954-1958 on the 5 units of Bhira Power Station. Nowadays the total installed hydro capacity is about 25,750 MW for approximately 74 TWh generation. For the dam and hydro plant R&U programme, a National Committee was constituted in 1987 to identify, plan and coordinate actions. 55 hydro schemes with an aggregate capacity of about 10,000 MW were identified for implementation of a R&U programme. During the year 2000, a National Perspective Plan document was established which updated the initial programme and extended the number of schemes to 107.

44 have already been completed during the VIIIth and IXth Plan and the first year of the Xth Plan (2002-2007) with a total of 2120 MW (including additional capacity, restoration of derated capacity and prevention of likely loss of capacity). 63 schemes are programmed during the Xth Plan (2002-2007) and 31 schemes (total of 4415 MW) during the XIth Plan (2007-2012).

3 A Framework for whom ?

This Framework will be used by the World Bank and its borrowing countries as a tool to facilitate the process through which high return dam and hydro plant rehabilitation and uprating projects can be identified, decided upon, funded and implemented, as a result of a better evaluation of all associated costs, risks and benefits in the particular context of each country. The Framework will also provide guidance for maximising the sustainability of those projects, taking into account social and environmental aspects, as well as technical, economic and financial ones.

Ultimately it must be noticed that the Framework is not intended to be a system planning instrument and that the Needs which are a key input for its application are supposed to have been previously assessed. In order to illustrate the main characteristics of any given power/water project,

the area of all possible options can be divided into four quadrants using a Structural/Non-structural axis and a Demand/Supply axis.

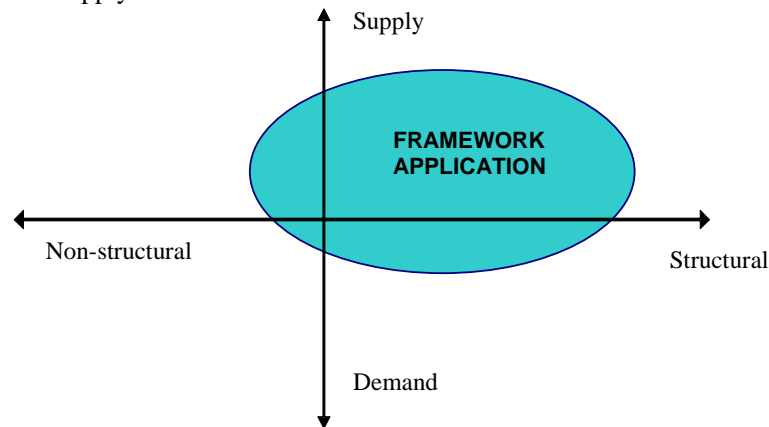


Figure 4: Framework application

4 The proposed Decision Making approach

The Framework proposes a specific and practical Decision Making approach for R&U projects, with the objective of establishing a selection of prioritised projects which can be readily funded and implemented. The proposed process includes 6 main steps:

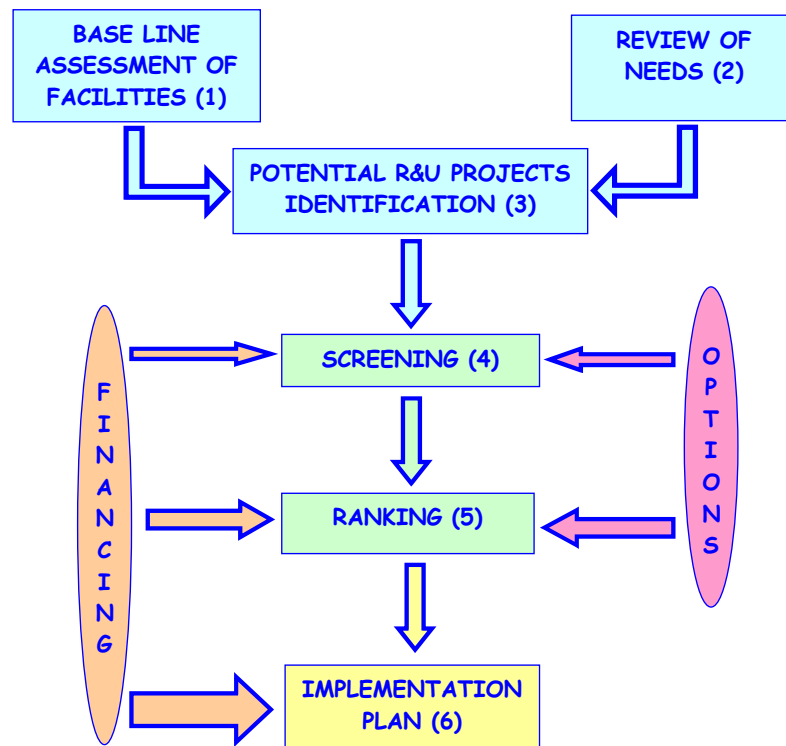


Figure 5: Flow chart for the Decision Making process

- 1- Base line assessment of existing dams and hydro plants, including identification of options for uprating and performance optimisation.
- 2- Review of the identified needs regarding water and power supply, safety, preservation of the environment and social development.

- 3- Identification of potential R&U projects on the basis of steps 1 and 2.
- 4- Screening of those potential projects using a qualitative multi-criteria analysis, in order to select a workable number of projects for the subsequent stages of the process.
- 5- Ranking of the remaining projects, using a quantitative multi-criteria approach involving an in-depth economic analysis but also other criteria such as risk exposure level, social and environmental performance, likelihood of financing and time needed for implementation.
- 6- Preparation of an implementation plan, including a basic implementation schedule, anticipated financing arrangement, procurement strategy, preliminary business plan and Terms of Reference for the Feasibility Study which needs to be performed as a next step in order to come up with a bankable project.

The systematic reference to the needs and the early introduction of financing considerations are key components of this approach and should enhance the robustness of the final result. The proposed approach also aims at performing option assessment in a realistic manner.

It should be emphasized that this proposed approach is not a universal recipe. There is an obvious need for customisation to each particular context, starting with a definition of the main objectives and taking into account that some projects may already be ready for implementation.

The Framework includes typical Terms of Reference for the performance of each step.

5 Financing approach

R&U projects usually enjoy an attractive economic internal rate of return (IRR), frequently above 20%. However securing the funds for the project may remain a challenge, even though at a lesser extent than for new projects.

Therefore, financing considerations must be part of the decision making process at a very early stage in the development of a R&U programme. For instance, the likelihood for a project to actually be attractive to financiers is one of the criteria applied at the screening stage.

The stream of revenues starts way before the end of the project for R&U projects (e.g. as soon as the first unit is rehabilitated and commissioned). Accordingly, long overall R&U project duration (e.g. large scale facilities with a large number of units) is not necessarily penalizing (by contrast with new projects).

A staged work approach may actually reduce the financing requirements, hence the financial costs. Innovative financing arrangements should be found to exploit this R&U partial self-financing potential. Support from multilateral funding agencies can be most needed at the beginning with private financing taking over later on. The role of governments as facilitators of private investments must be stressed, especially when utilities are short of corporate funds.

Box 1 shows an example of private sector involvement in R&U projects under the ROT (Rehabilitate, Operate, Transfer) model.

Box 1: R&U Programme for 13 HPPs (Macedonia)

In Macedonia, for a total of 432 MW installed hydro capacity, 420 MW are currently being rehabilitated by means of two different processes:

- From 1997 to 2004, the 6 major HPP (Vrutok, Raven, Vrben, Tikvesh, Spilje, Globocica) with a combined total of 400 MW (i.e. 90% of the total hydro capacity) were rehabilitated through World Bank funding: R&U Part 1.
- In 2000, Electric Power Company of Macedonia (ESM) initiated a ROT process aiming to entrust a foreign investor with comprehensive rehabilitation, operation and maintenance for a 11-year period for a set of 7 HPP (Dosnica, Kalimanci, Matka, Pena, Pesocani, Sapuncica, Zrnovci), with a combined total capacity of 29,7 MW (i.e. 7% of the total hydro capacity) : R&U Part 2. According to the project guidelines, the winner of the tender will have up to one year to inspect and conduct testing of the equipment at the hydro schemes and develop a detailed rehabilitation plan, with all the repair and upgrade work to be completed by the end of the third year. The investor will benefit from the project revenues during the remaining 8 years. At each key step of the process, periodic reporting will be transmitted to

ESM. At the end of the 11-year period, the HPP will be transferred back to ESM, with a specific warranty.

Figure 6: New runner for Tikvesh HPP



6 Moving Forward

Over and beyond the decision-making approach outlined here above, some key recommendations to both the decision makers and the financing community are summarized as here below:

- Owners should establish and maintain adequate O&M records to facilitate the base line assessment of their facilities,
- A clear allocation of responsibility between Owner and Operator in the Decision Making process is essential to ensure the switch from continuing maintenance to triggering an actual R&U project,
- Benefits from non-structural measures, such as water management optimisation should be fully exploited (see Box 2),

Box 2: Durance River Optimisation (France)

Optimisation of the Durance and Verdon river facilities, through mostly non-structural measures allowed major enhancement of the service rendered by the facilities to the French electrical system. Thanks to the commissioning of the Sainte-Tulle control centre, all the 19 facilities with 1980 MW total capacity can now be operated synchronously as peaking. The total cost of the project (including hydraulic studies, software and hardware at the control centre and all plants as well as structural measures) was amortized in less than 1 year.

Figure 7: Mallemort power plant along Durance river



- Windows of opportunities for R&U implementation should be identified and exploited (e.g. periods during which the impact and cost of shutdown is minimum),
- R&U projects should be packaged in a cohesive bankable format,
- While supplier's know-how in modernisation techniques has to be put to good use, Decision-Making should remain independent of supply interest,
- Innovative and flexible procurement arrangement, consistent with the often staged decision process, should be encouraged,

- A sound new maintenance programme should be put in place to ensure the sustainability of the benefits obtained from R&U,
- The Uprating option should be systematically considered when assessing a programme for the development of new facilities,
- Opportunities to address existing environmental and social conditions should be considered in the R&U project and a proper sharing of benefits, costs and responsibilities between the various stakeholders should be aimed at,
- Adequate regulation should be put in place, ensuring that R&U projects can be properly developed and implemented, in particular at the time of relicensing,
- Since R&U projects can start to deliver additional revenues in the very course of their implementation, a long project duration should not necessarily be viewed as a deterrent and innovative financing models should be envisaged in order to better take into account this specificity,
- Multilateral Financing institutions have a key role to play, notably in providing funding for the R&U project costs for those projects which do not yield direct financial revenues, such as dam safety programmes,
- Public-Private partnerships should be encouraged and adapted to the favourable risk profile of R&U projects,
- There is a need to raise awareness about the unique benefits of R&U projects among the decision-makers as well as the financing communities.

Last but not least, the benefits of “Learning by doing” should be highlighted. The lessons learned from the actual implementation of early R&U projects are essential when building a sound policy and well fit decision-making process along the more general lines of this proposed Framework.

As a concrete example, Turkey has been selected as one of the case studies for the establishment of this Framework, considering its high potential for rehabilitation and/or uprating projects. The case study consists in assessing how the Framework could be applied in the Turkish context, what could be expected as an output in terms of decision-making and how it could actually lead to implementation of specific R&U projects. The full implementation of the Framework and feasibility study is now in progress and consists in the assessment of 15 hydropower plants distributed into 6 projects.

This pragmatic approach, used in the Turkish context, will result in a selection of the best project taking into account the different requirements and other options. This project may eventually become part of the World Bank financed “Energy Liberalization” project in Turkey.

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