

# Batoka Gorge Hydro Electric Scheme

Zambezi River  
in Zambia and  
Zimbabwe

Project  
Information  
Memorandum

November 2017

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PREPARED FOR:  
ZAMBEZI RIVER AUTHORITY



PREPARED BY:  
NEW PARTNERSHIP FOR AFRICA'S DEVELOPMENT (NEPAD)



UNDER THE FRAMEWORK OF:  
PROGRAMME FOR INFRASTRUCTURE DEVELOPMENT IN AFRICA (PIDA)





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# 1. PROJECT DESCRIPTION

## 1.1 CONTEXT AND OBJECTIVES

Development of a hydropower scheme on the Zambezi River 54km downstream of Victoria Falls (“the Project”) has been investigated in various forms since 1904, when geological investigations for potential sites commenced. Between 1972 and 1998 several studies investigated Batoka Gorge as a potential site for a hydroelectric scheme.

In 2014, ZRA appointed Studio Pietrangeli Consulting Engineers (Studio Pietrangeli) to update the Engineering Feasibility Study prepared in 1992 by the Batoka Gorge Joint Venture Consultants. ZRA also appointed Environmental Resources Management Southern Africa (Pty) Ltd. (ERM) to update and carry out an Environmental and Social Impact Assessment (ESIA), and Ernst & Young (EY) to advise on the financial, legal and commercial aspects of the project. A quantitative options analysis was prepared by EY in 2016 (2016 Options Analysis) that included a preferred commercial structure for the Project based on international market soundings undertaken. The 2016 Options Analysis is the source of financial information contained in this PIM<sup>1</sup>.

## 1.2 PROJECT LOCATION

The Project is to be located in the central portion of the Zambezi River Basin, and will extend across the international boundary between Zambia and Zimbabwe. It will be situated upstream of the existing Kariba Dam hydroelectric scheme on the Zambezi River and downstream of the Victoria Falls (see Figure 1).

## 1.3 IMPLEMENTATION STAGE & PROJECT STATUS

According to PIDA’s Priority Action Plan (PAP), the Project’s status is ‘**S3A – Project Structuring, Transaction Support & Financial Close**’. However, there are three core components of the Project’s implementation, which need to be completed before the mobilisation of funding can be finalised, namely (1) a technical feasibility assessment, (2)

<sup>1</sup> The PIM also referenced information from the Project Overview Document (March 2017) prepared by EY, but which also makes use of the 2016 Options Analysis outputs.

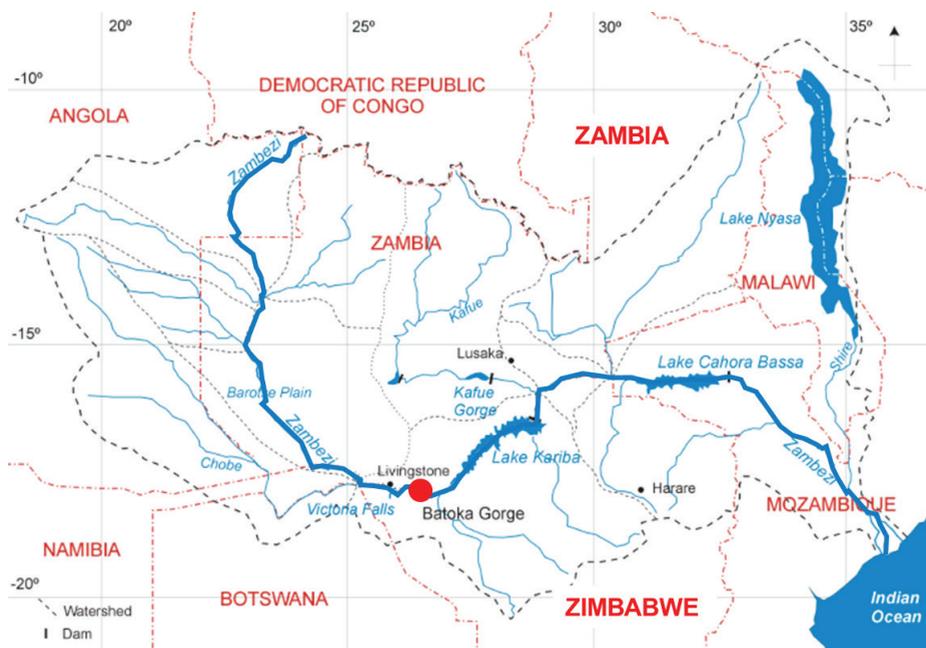


Figure 1: Project location along Zambezi River.

an environmental and social impact assessment, and (3) legal and financial structuring. The progress of each of these is noted below:

- **Engineering Feasibility Studies (EFS):** The review and updating of the Engineering Feasibility Studies, being undertaken by Studio Pietrangeli, is expected to be completed by the end of 2018. These studies involve the review and updating of the 1993 Engineering Feasibility Studies of the proposed scheme.
- **Environmental and Social Impact Assessment (ESIA) Studies:** The assessment of the environmental and social impacts of the proposed scheme and development of strategies to mitigate any identified negative impacts and enhancement of identified positive impacts is in progress. The studies are being undertaken by ERM, and are expected to be completed by the end of 2018.
- **Legal and Financial Transaction Advisory (LFTA) Services:** The Authority has appointed a consortium of EY, Tata Consulting Engineers and Webber Wentzel to provide transaction financial and legal advisory service for the development of the Project. The services expected to be completed by the end of 2018.



The preparatory activities will be followed by mobilisation of funds and procurement of developers/contractors. Thereafter, construction works will commence leading to commissioning of the Project<sup>2</sup>.

## 1.4 KEY PARTIES

### 1.4.1 PROJECT SPONSOR & IMPLEMENTATION AUTHORITY



**ZRA** (the Zambezi River Authority) is a corporation jointly and equally owned by the governments of Zambia and Zimbabwe, is the implementing agent for the Project and also acts as the Project's sponsor. ZRA was formed by the Zambezi River Authority Act of 1987 (Act No. 17 and 19 for Zambia and Zimbabwe, respectively) and is governed by a Council of Ministers. The Council of Ministers consists of four members: two in the Republic of Zambia, and two in Zimbabwe. The Ministers are those holding portfolios of Energy and Finance in the respective countries.

### 1.4.2 OTHER KEY PARTIES

The two principal stakeholders are the two respective power utilities as noted below:



**ZESCO Limited** is a parastatal, with the main function of producing power in Zambia. ZESCO produces approximately 80 % of the electricity consumed in the country and has historically been the main player in the generation, transmission and distribution of electricity in Zambia. In addition, ZESCO represents Zambia in the Southern African Power Pool. The electricity produced by the proposed BGHES will be sold to the national grid, which is managed and maintained by ZESCO.

<sup>2</sup> Targeted for 2024.



**ZESA** (Zimbabwe Electricity Supply Authority), officially called ZESA Holdings (Pvt) LTD., is a state-owned company whose task is to generate, transmit, and distribute electricity in Zimbabwe. It has organized this task by delegation to its subsidiaries, the energy generating company Zimbabwe Power Company (ZPC) and the Zimbabwe Electricity Transmission and Distribution Company (ZETDC). ZESA is the majority electricity generator and supplier for the public grid. There are other independent power producers which generate and supply power to the grid on a relatively smaller scale. ZESA represents Zimbabwe in the Southern African Power Pool.

Other key stakeholders include the following agencies and entities:

- Ministry of Finance, Zambia
- Ministry of Finance and Economic Development, Zimbabwe
- Ministry of Mines, Energy and Water Development, Zambia
- Ministry of Energy & Power Development, Zimbabwe
- Energy Regulation Board, Zambia (“ERB”)
- Zimbabwe Power Company, (“ZPC”)
- Zimbabwe Electricity and Distribution Company (“ZETDC”)
- Zimbabwe Energy Regulatory Authority (“ZERA”)

## 1.5 DELIVERY & BUSINESS MODELS

A number of commercial structures, ranging from privately owned, operated and financed to publicly owned, operated and financed were evaluated during a qualitative options analysis. In December 2016, the Council of Ministers approved the preferred commercial structure for the Project based on the following key criteria, namely:

- The need to minimise the amount of additional debt on each countries’ balance sheet;
- Feedback from an international market sounding process; and
- Results from a qualitative options analysis undertaken.



The Council of Ministers adopted a split commercial structure whereby the dam would be owned by ZRA, and the power plants would be developed under a project finance structure and owned by Special Purpose Vehicles (“SPVs”) with equity being provided by the private sector and the relevant country’s utility, and debt being raised from the private sector and DFIs. The dam will be financed by debt and grants raised by the respective countries, and then on lent to ZRA through subsidiary agreements between the Authority and the governments of Zambia and Zimbabwe. This commercial structure is summarised in Table 1.

Table 1: Selected commercial structure for dam and power plants.

	OWNERSHIP	FINANCING
<b>NORTH BANK POWER PLANT</b>	North Bank Power Co.	Public / Private
<b>DAM</b>	ZRA	Public
<b>SOUTH BANK POWER PLANT</b>	South Bank Power Co.	Public / Private

The dam will be delivered under a design and construction contract (i.e. an EPC contract) and ZRA will select a contractor through a competitive tender process who will undertake the detailed dam design and construction. ZRA will operate and maintain the dam and will be compensated via water payments made by the SPVs or Power Companies in accordance with the terms of their water supply contracts. ZRA may choose to subcontract certain services if the necessary expertise or capacity is not available in-house, such as the periodical major maintenance of the dam wall. Figure 2 illustrates these ownership and contracting structures.

Financing for each power plant (i.e. South Bank Power Co. and North Bank Power Co. collectively referred to as the SPVs) will be undertaken based on project finance structure with a combination of equity and debt finance. An EPC contract has been identified as the best form of contract for the power plants and is fairly standard for projects developed under this type of structure.

Each SPV will be responsible for financing and constructing their respective power plants. Operations & maintenance for the power plant will also be the responsibility of the SPVs who will enter into O&M contracts to deliver these services. The SPVs will enter into power purchase agreements (PPAs) with ZESCO and ZPC which will be supported by back to back Power Export Agreements (PXAs) between ZESCO/ZPC<sup>3</sup> and other regional utilities. The

3 An Implementation Agreement is currently being developed which will provide a direct contractual obligation and undertaking between the Government of Zambia and Zimbabwe and each SPV.

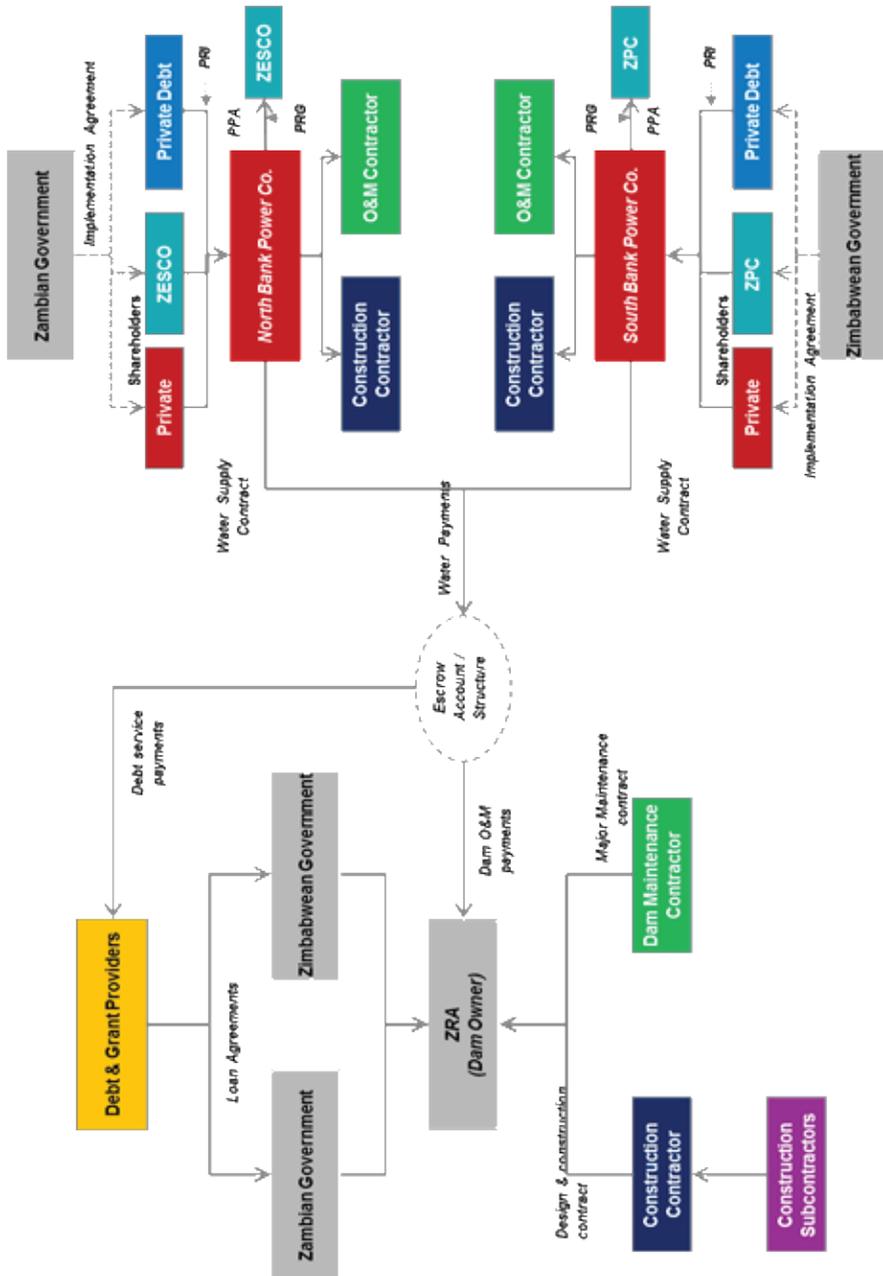


Figure 2: Selected ownership and contracting structures.



Council of Ministers approved a procurement strategy in December 2016 that will require four separate procurement processes for the following Project components:

- Financing of the dam;
- Construction of the dam;
- North Bank SPV (including design, construction, financing, operations and maintenance); and
- South Bank SPV (including design, construction, financing, operations and maintenance).

Transmission infrastructure and the water transfer tunnels in each country have been included as part of the scope of the respective power plant SPV's construction and financing obligations. At commissioning the transmission infrastructure will be transferred to the respective utilities that will then operate and maintain these assets in the usual manner.

### 1.5.1 PRIVATE SECTOR OPPORTUNITIES

The Dam will be owned and financed by ZRA, and delivered using an Engineering, Procurement and Construction (EPC) contract; therefore, an opportunity exists for the private sector to act as EPC contractor.

The power companies or SPVs present the larger opportunity for private sector participation, as they will be developed using an independent power producer (IPP) model that will require the private sector to provide equity and to raise debt funding. The SPVs will also enter into EPC contracts for the construction of the two power plants and associated infrastructure.

## 1.6 REVENUE MODEL

### *Water Payments*

ZRA will be entitled to water payments under the water supply contracts which will be paid into an escrow account by the two SPVs. The water payments will be structured to comprise both a capacity charge (to cover fixed costs and debt repayments) and a variable charge. The payment mechanism for the water supply agreement assumes that the hydrological risk (in terms of reduced volume of water flow, and hence reduced power supply) will predominantly



be taken by the utilities and ultimately power consumers. However, the following mitigating measures have been proposed to reduce the risk to the utilities and the power consumers, namely:

- Establishment of a cash reserve via a capacity charge margin which could be used to fund debt repayments during periods of sustained low water flow.
- The utilities may take out weather related insurance to cover certain low probability events.
- The utilities may take some of the risk exposure in the short term, which could be recouped over time from higher energy tariffs to end users.
- Government support in the form of top up payments during periods of reduced water flow.

The water payments will be passed through to ZESCO and ZPC via two PPAs and ultimately to power purchasers.

### *PPA Payments*

The capital expenditure (capex) costs of constructing the two power plants and the annual operation and maintenance costs of the plants will be passed on to ZESCO and ZPC via the two PPAs. The power purchase agreements (“PPA”) between the SPVs and ZESCO/ZPC will have a ‘tariff’ which is split between:

- An **availability charge** for making their power plant available to provide power and this charge will cover the capital expenditure involved in building the power station, water payment capacity charges as well as its fixed operating expenditure; and
- A **usage charge** for the marginal cost of generating power as and when required and such charge usually covers the cost of the fuel (and in this case, the variable component of water payments) required for the facility to generate power.

Under the proposed tariff arrangement, the flow of funds to the SPVs are not wholly dependent on the amount of power required by ZESCO/ZPC or the regional utilities that they are supplying, as the availability charge is required to be paid to the SPV whether or not power is required by the purchaser of such power.

In terms of political support for the Project, it is evidenced by the involvement of the Council of Ministers who approved a commercial structure for the Project in December 2016.



## 2. TECHNICAL FEATURES

### 2.1 OVERVIEW

Based on the latest engineering studies, the current technical configuration under consideration for the Project comprises:

- A 181m high, 720m long roller compacted concrete gravity arch dam;
- A radial gated crest type spillway;
- Four intakes in the reservoir which will take the water through 4 tunnels (each approximately 1km in length) to the two surface power plants downstream of the dam;
- Two surface power plants, one on either side of the river bank, each having a capacity of 1,200MW, with a combined capacity of 2,400MW;
- 6 x 200MW turbines in each powerhouse; and
- Transmission lines: 330kV in Zambia and 400kV in Zimbabwe.

The 400kV lines directed to Zimbabwe will go to the Hwange thermal power station, and in Zambia the outgoing 330kV lines from the Project will go to the future Livingstone station.

### 2.2 CAPACITY

An updated energy production study was undertaken in 2016 which quantified the monthly energy that can be produced by the Project based on 89 years' data (i.e. 1925 to 2014) as illustrated in Table 2<sup>4</sup>. The study forecasts that 5,883 GWh of firm energy could be produced per annum by the 2,400 MW of installed capacity. The results of the energy production study indicate that the plant should be operated as a run of the river scheme with the water level corresponding to the full supply level, in order to maximize the energy production.

<sup>4</sup> Source: 375 GEN R SP 001 C – Vol IV – Res. Operation & En. Prod. Studies Report, March 2016



Table 2: Quantified monthly energy outputs by the Project.

<b>GWH</b>	<b>FIRM ENERGY<sup>5</sup></b>	<b>SECONDARY ENERGY<sup>6</sup></b>	<b>TOTAL ENERGY</b>
<b>JAN</b>	<b>413</b>	<b>269</b>	<b>682</b>
<b>FEB</b>	<b>528</b>	<b>377</b>	<b>905</b>
<b>MAR</b>	<b>826</b>	<b>508</b>	<b>1,334</b>
<b>APR</b>	<b>1,008</b>	<b>445</b>	<b>1,453</b>
<b>MAY</b>	<b>1,049</b>	<b>475</b>	<b>1,524</b>
<b>JUN</b>	<b>577</b>	<b>730</b>	<b>1,307</b>
<b>JUL</b>	<b>395</b>	<b>433</b>	<b>828</b>
<b>AUG</b>	<b>299</b>	<b>208</b>	<b>507</b>
<b>SEP</b>	<b>215</b>	<b>137</b>	<b>352</b>
<b>OCT</b>	<b>172</b>	<b>107</b>	<b>279</b>
<b>NOV</b>	<b>159</b>	<b>113</b>	<b>272</b>
<b>DEC</b>	<b>242</b>	<b>182</b>	<b>424</b>
<b>TOTAL</b>	<b>5,883</b>	<b>3,984</b>	<b>9,867</b>

5 Energy produced guaranteed with a reliability of 95%

6 Energy produced in excess of the firm energy (i.e. during high flows periods)



## 3. SECTOR

### 3.1 SCOPE OF SECTOR IN ZAMBIA & ZIMBABWE

Zambia's current installed generation capacity is around 2,350 MW made up of a range of hydro and diesel generation facilities and Zimbabwe's current installed generation capacity is around 1,960 MW made up predominantly of coal and hydro generation facilities. The Project would add a further 1,200 MW of installed hydro capacity to each country and 2,400 MW to the SAPP region.

### 3.2 MARKET SIZE, DEMAND & PROJECTIONS



**Zambia's** installed power generation capacity is 2,350MW consisting of 94% hydro, 3% thermal power and 2% HFO, with IPPs currently contributing only 9% to total power generation. Electricity demand currently stands at 1,987MW, and will grow to 5,508MW in 2035 at a compounded annual growth rate of 5.4%. The country's GDP is forecast to grow at 6.5% over that same period.



**Zimbabwe's** demand is forecast to grow from 2,116MW in 2015 to 5,301MW in 2035s, per the ZETDC System Development Plan April 2015. Negative GDP growth seen in 2016 is expected to continue in 2017 with a further contraction of 1.7% in GDP expected. Growth is expected to be constrained, but increasing to 1.3% in 2019.

The introduction of new generation projects will be critical to meeting this projected demand in both countries. Additionally, there are several planned SAPP regional projects which could assist the evacuation of power into the SAPP region including the Zimbabwe-Zambia-Botswana-Namibia (ZIZABONA) interconnection project.

#### *Southern African Power Pool (SAPP)*

Energy demand in Sub-Saharan Africa grew by 45% between 2000 and 2012 and given the population growth and industrialisation in the region is expected to continue to grow.



Despite having 13% of the world's population the region only accounted for 4% of the world's total energy demand.

Between 2016 and 2023, SAPP is expected to add 24.8GW of generation capacity comprised of 44% hydro, 44% coal thermal, 11% gas and the rest being non-hydro renewable energy. This will increase the current installed capacity of 62GW to 87GW (82GW when the unpredictable wind and solar capacity is discounted). Project Cost and Funding.

### 3.3 PROJECT COSTS

The project costs for the Project's three construction components are set out in Table 3 which totals \$3.5 billion of which \$2.9 billion represents construction costs. It is assumed that the SPVs will be funded on a 30% equity and 70% debt basis whilst the dam will be wholly debt funded.

Table 3: Capital outlay for the three Project components.

USD'000, 2015 TERMS	DAM	SPV1/ NORTH BANK POWER CO.	SPV2/ SOUTH BANK POWER CO.	TOTAL
CONSTRUCTION COSTS	1,642,076	617,582	617,582	2,877,240
INTEREST DURING CONSTRUCTION	400,737	64,763	64,763	530,263
PRE-FUNDING OF DSRA	-	27,734	27,734	55,468
ARRANGEMENT FEES	58,818	16,655	16,655	92,128
COMMITMENT FEES	36,498	4,956	4,956	46,410
AGENCY FEES	700	325	325	1,350
<b>TOTAL PROJECT COSTS</b>	<b>2,138,829</b>	<b>732,015</b>	<b>732,015</b>	<b>3,602,859</b>
EQUITY	-	219,552	219,552	439,104
SENIOR DEBT	2,138,828	512,464	512,464	3,163,756
<b>TOTAL SOURCES OF FUNDS</b>	<b>2,138,828</b>	<b>732,015</b>	<b>732,015</b>	<b>3,602,858</b>

### 3.4 FINANCIAL ANALYSIS

A financial model was developed for the Project as part of the 2016 options analysis which calculates the required water payment to cover the dam's forecast financing and operational costs. This water payment is then fed into the SPVs' cashflow model as an expense together with the power plants' operational costs, financing costs and tax assumptions to calculate a power payment (see Figure 3).

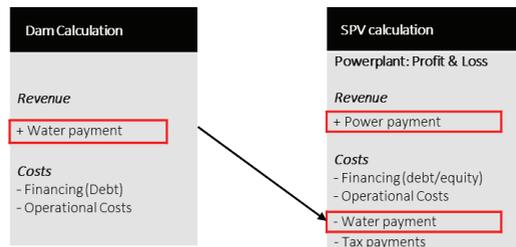


Figure 3: Cash flow illustration for the payment of water by the power plants' SPVs.

The base case analysis assumed that the two SPVs will generate and feed 9,542 GWh of power annually into the grid<sup>7</sup>. The modelling concluded that the SPVs will require a power payment/tariff at US\$c 3.2 per kWh to cover its costs, including the water payment, and to ensure returns for shareholders (see Table 4). These were calculated using an assumed Project IRR of around 10.0% (USD real-terms)<sup>8</sup>.

Table 4: Calculated water and power payment tariffs.

COMPONENT	POWER PAYMENT (\$/KWH)	WATER PAYMENT (\$/KWH)
DAM CAPACITY CHARGE	1.19	-
DAM FIXED O&M CHARGE	0.17	-
DAM VARIABLE O&M CHARGE	-	-
<b>WATER PAYMENT TO ZRA</b>	<b>1.36</b>	<b>1.36</b>
SPV CAPACITY CHARGE	1.59	-
SPV FIXED O&M CHARGE	0.26	-
SPV VARIABLE O&M CHARGE	-	-
<b>POWER PAYMENT/TARIFF (2015 TERMS)</b>	<b>3.22</b>	-

<sup>7</sup> The generation capacity assumes a water level at the FSL for most part of the year and a water level at 740 m a.s.l. during the dry months (August to December).

<sup>8</sup> Modelled using 6-month LIBOR plus 300bp for the dam and 750bp for the IPPs.



### 3.5 RESOURCE MOBILIZATION OPPORTUNITY

#### *Concessionary loans for the dam component of the Project*

To unlock funding for the dam component of the Project, two key issues will need to be addressed, namely: Zimbabwe's debt arrears; and the potential impact of climate change on the Project<sup>9</sup>. Zambia's overall external debt to GDP levels increased at a moderate rate between 2006 and 2013 from 18.6% to 21.6%. However, poor commodity prices, slower growth and the weakening exchange rate saw a steep increase to 39.5% in 2015 and further increases are expected through to 2018. This will put pressure on spending in Zambia, limiting the ability of the economy to raise more debt to fund investment.

Zimbabwe's level of total debt outstanding has increased over the last ten years. However, the rate of increase in debt, since 2006, has been slower than Zambia's, partially due Zimbabwe's already high levels of external debt. As of end-September 2016, Zimbabwe's total arrears to the IBRD and IDA amounted to US\$1,156.7 million, and arrears to the AfDB amounted to US\$632.5 million. Zimbabwe's high levels of external debt is putting stress on government revenue as well as limiting any headroom to increase borrowing.

Given Zimbabwe's debt arrears, innovative approaches will need to be considered that will allow DFIs to extend concessionary loans to the dam component of the Project as the proposed structure will require both countries to increase their external debt levels by around US\$1,069 million or US\$2,139 million in total. NEPAD can seek to facilitate a discussion between Zimbabwe's lenders<sup>10</sup> and potential funders to understand how funding for the dam can be unlocked given Zimbabwe's current arrears. Climate finance mechanisms, such as the Green Climate Fund (GCF), should be investigated as either providers of subordinated debt to the dam component of the Project or as providers of guarantees to the senior lenders. Both mechanisms would reduce the risk to senior lenders in the event that the proposed water payments are insufficient to cover repayments to all lenders. Grants should also be investigated as a means of reducing the dam's debt requirements, especially in respect of Zimbabwe's portion, but are only likely to cover a portion of the funding requirement.

#### *Project bonds and construction period DFI loans for the SPVs*

An opportunity may exist to finance the two SPVs via project bonds once the power plants

<sup>9</sup> The AfDB has been mandated to act as lead arranger in respect of the debt required for the Project.

<sup>10</sup> Such as IBRD, IDA, AfDB.



have been commissioned and offtake agreements have been put in place with regional off-takers. This funding approach would only make use of concessionary loans during the construction period and commissioning phase, allowing concessionary lenders to recycle their loans earlier. Project bonds may also offer an opportunity to raise funding in local currencies which may be attractive to Zambian and Zimbabwean institutional investors.

IPPs are well-understood by regional institutional investors as a result of the REIPPP programme in South Africa. Whilst the REIPPP programme offered lenders certainty in respect of offtake through a single PPA with ESKOM, the Project currently requires additional offtake agreements with regional utilities to provide certainty in respect of cash flows as the SPVs' generation capacity will exceed local demand in the near term. Using concessionary loans during the construction and commissioning phase would provide ZESCO and ZPC with a grace period to negotiate regional offtake agreements and to strengthen the Project's credit structure.

Once the regional offtake agreements are in place, the two SPVs could appoint a bond arranger to structure project bond(s) that will be secured against the cash flows of the two SPVs. To enhance the bonds' credit quality to a level that will be acceptable to regional institutional investors, guarantees may be required from DFIs or the GCF. It is recommended that the proposed funding mechanisms are further investigated and modelled to understand the coupons that the SPVs will be able to offer institutional investors. The outputs from the modelling exercise could also be used to undertake market soundings with DFIs and the GCF in respect of the associated concessionary loans and guarantees.

## 4. ENVIRONMENTAL, SOCIO-ECONOMIC IMPACT & SUSTAINABILITY

### *Environmental*

The following key environmental impacts have been noted by ERM:



**Water abstraction:** The Upper Catchment of the Zambezi above Victoria Falls is predominantly rural and the largest abstractions from the river and its tributaries are for irrigated agriculture. The total estimated direct abstractions in 2010 in the Upper Catchment of around 86 million m<sup>3</sup>/yr represent approx. 0.3% of the annual runoff at Victoria Falls.



**Water Quality:** It was found through the recent studies that there has been no significant change in the chemical constitution of the water above Victoria Falls in recent decades, and that water quality conditions at that point are generally indicative of a largely unpolluted, undeveloped catchment.



**Water Flows:** The proposed BGHES will be operated primarily as a run-of-river scheme, with the option of daily peaking, with the majority of its power generation capacity in the high flow season. However, daily peaking may result in significant impacts on the riverine ecosystem due to flow disturbance, but this will depend ultimately on the final peaking and minimum flow conditions adopted (such operating rules are under consideration).



**Ecology:** The construction of large dams on the Zambezi River are converting long stretches of flowing riverine habitat to broad standing water pelagic habitat, which creates significant fragmentation effects to large numbers of species, such as lesser mammals, birds and reptiles. The natural flow regime of the Zambezi River is being affected by a number of hydropower schemes that currently exist, are under construction or are planned for the near future.



**Fauna, Fish and Reptiles:** The local Taita Falcon population is the single largest known population, and any impacts could affect the species as a whole, and the loss of Rock Pratincole habitat could result in a shift in their distribution patterns. The fish communities within the Batoka Gorge are considered to be in a natural state with minimal utilisation due to the inaccessibility of the habitat, and no unique fish species are known to occur within the gorge. A large Nile crocodile population is present in the lower reaches of the Zambezi River before Lake Kariba, which declined dramatically in the 1950s and 1960s but has since recovered and many mature breeding adults are now present.

### *Socio-Economic Impact & Resettlement*

The proposed Project is expected to cause some in-migration into the project area and surrounds related to the arrival of opportunistic economic migrants and migrant labour. The likelihood and scale of this in-migration is likely to increase with other potential housing developments in the area, specifically the specifically the Ndlovu and Jambezi Housing Schemes in Zimbabwe (40 km outside of Victoria Falls). Positive benefits associated with the Project include increased employment, purchase of local goods and services, social investment, and community development. These may be enhanced by other projects in the area provided that these also promote the employment of local people and procurement as far as possible. Resettlement may be required for the transmission aspects of the Project. The Projects Resettlement Action Plan (RAP) will be compiled to meet international good practice and will ensure that negotiated compensation/replacement packages are provided.

### *Sustainability*

Although there are several uncertainties regarding the forecast climatic changes, it has become standard practice to evaluate the effects of climate change above all in relation to exploitation of water resources since these could decrease, jeopardizing the usefulness of a long-term project such as a hydropower plant. The effect of the potential climate change on the hydrological regime has been estimated on the basis of the numerical calculations of the Global Circulation Model (GCM). Three emission scenarios (RCP, Representative Concentration Pathway) were modelled for the power production period of 2020-2044, and the results are summarised in Table 5<sup>11</sup> and are in line with three other studies completed between 2011 and 2015.

<sup>11</sup> Source: 375 GEN R SP 001 C – Vol IV – Res. Operation & En. Prod. Studies Report, March 2016.



Table 5: Flow and energy outputs of emission scenarios of the Project.

MODEL	RCP8.5		RCP8.5		RCP 4.5	
	1990-2010	2000-2010	1990-2010	2000-2010	1990-2010	2000-2010
BASELINE						
FLOW REDUCTION	-43%	-8%	-35%	-6%	-34%	-4%
ENERGY REDUCTION	-25%	-3%	-18%	4%	-20%	(-1%)

Considering the most probable emission scenario (RCP 4.5), the reduction of the energy production is forecast to vary between -1% and -20%, depending on the baseline scenario adopted.

#### 4.1 JOB CREATION

During the operation and maintenance (O&M) phase, based on comparably sized hydro projects, the BGHES is expected to employ 50 - 100 fulltime staff. Most of the staff are expected to be Operators and Shift Engineers (up to 30 staff) followed by General Works (16 staff) and up to 14 Skilled Electricians and Electrical Engineers. The number of jobs created during the construction phase is more difficult to estimate, as it varies widely depending on the location, project size, local unemployment rates, labor costs, and training required. For example, the 120MW Itezhi Tezhi hydro plant in Zambia, officially commissioned February 2016, showed great variations of the number of jobs during construction. As many as 900 skilled, semi-skilled and unskilled workers were employed in October 2014, and as few as 240 workers in March 2013. The Feasibility Study notes that more accurate labour estimates will be included during the detailed design phase of the EPC contracts.



## 5. GOVERNANCE & RISKS

### 5.1 GOVERNANCE STRUCTURE

#### *Supporting Legislative Framework*

Based on the legal analysis undertaken to date it is believed that the implementation of the Project, is permitted within the existing legal regulatory framework in both Zambia and Zimbabwe. In Zambia the Public – Private Partnership Act 14/2009 is the principal legislation setting the supportive legal framework for the Project whilst in Zimbabwe the corresponding principal legislation is the Procurement Act [Chapter 22:14] which, amongst others, recognises project development modes such as Build Operate and Transfer.

#### *Project Development*

ZRA has been mandated by the Governments of Zimbabwe and Zambia to develop the Project.

#### *Interstate Agreement (ZRA Act)*

The Governments of Zambia and Zimbabwe have entered into an interstate agreement in respect of the use and management of the Zambezi Scheme. The Agreement sought to, inter alia, derive the greatest possible benefit for Zambia and Zimbabwe from the natural advantages offered by the Zambezi Scheme, as well as improve and intensify the utilisation of the waters for the production of energy. In terms of the ZRA Acts and the Agreement, the Governments of Zimbabwe and Zambia are required to contribute equally to the development of infrastructure within the Zambezi Scheme.

### 5.2 RISK MATRIX

A comprehensive risk assessment and framework has been developed for the Project, whereby project risks were identified, quantified and appropriate mitigation measures proposed. The key risk allocations are noted in Table 6.



Table 6: Key risks allocations for dam and power plants.

<b>RISK</b>	<b>DAM ALLOCATION OF RISK</b>	<b>POWER PLANTS ALLOCATION OF RISK</b>
<b>DESIGN</b> Time and cost overruns as a result of errors in the design, apparent during the construction phase.	Dam Construction Contractor	Power Plant Construction Contractor
<b>CONSTRUCTION</b> Time and cost overruns as a result of construction contractor not being able to meet the agreed programme.	Dam Construction Contractor	Power Plant Construction Contractor
<b>INTERFACE</b> Risk that either the construction of one component i.e. The dam or power plants impacts the completion of the other component.	Dam Construction Contractor to a point then Governments of Zambia and Zimbabwe (Shared)	Power Plants Construction Contractor to a point then Governments of Zambia and Zimbabwe (Shared)
<b>HYDROLOGICAL</b> Due to lower or higher-than-expected water flows, floods, unusual seasonal variations.	Passed onto the off-takers (i.e. ZESCO/ZPC) via the PPAs but may be mitigated through measures discussed below.	
<b>GEOLOGICAL</b> Unforeseen geological conditions resulting in additional costs.	Governments of Zambia and Zimbabwe	Governments of Zambia and Zimbabwe
<b>OTHER GEOLOGICAL</b> Other known geological risks.	Dam Construction Contractor	Power Plant Construction Contractor
<b>ENVIRONMENTAL</b> International objection on social, environmental or cultural grounds.	Governments of Zambia and Zimbabwe	Governments of Zambia and Zimbabwe



Construction interface risk will be a material risk given that the dam and two power stations will be procured separately. Two potential contractual options are currently being considered to mitigate the construction interface risk, namely:

- An umbrella wrap contractual arrangement; and
- A coordination and interface contractual arrangement.

The payment mechanism for the water supply agreement assumes that the hydrological risk (in terms of reduced volume of water flow, and hence reduced power supply) will be predominantly taken by the utilities (and ultimately power consumers) who in turn will seek to mitigate this risk. There are a number of options (or combination of options) potentially available to the utilities/governments to manage the risk of higher energy costs in periods of low river flow as described under the revenue section of this PIM.



## 6. TIMELINES & MILESTONES

Figure 4 illustrates the project preparation milestones and target dates to develop the requisite tender documents and reach financial close. Emphasis is given for the current project period, which is between the final project overview and the full feasibility study. Current projections for the implementation of the Project suggest a construction period of about seven years.



Figure 4: Project preparation milestones and requisite actions for the Project's financial close.



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**INTERVIEWS**

**Mr Edward Kabwe**, Director of Finance, Zambezi River Authority (ZRA), Lusaka, Zambia.

Interview conducted on Wednesday 1<sup>st</sup> November 2017.

**VERSION CONTROL**

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VERSION 1	10 November 2017	Pegasys	NEPAD Awaiting feedback from ZRA, ZESA, ZESCO



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