PROGRAM DOCUMENT

Preparing For Small-Scale Hydropower Development in Sierra Leone

Sierra Leone

Upgrading the Hydro-Meteorological Network & Database for Small-Scale Hydropower

ECOWAS Centre for Renewable Energy and Energy Efficiency
www.ecreee.org

Imprint

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Author: Dr. Jan Grzegorz Perzyna, HYDRO_CONSULTING

This program document was developed in close cooperation with ECREEE and with the respective authorities and stakeholders of Sierra Leone, such as Ministry of Energy, Ministry of Water Resources, Fourah Bay College (University of Sierra Leone).

In parallel also a program document on the same topic based on the needs for small-scale hydropower development in Guinea was developed

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This program document is part of the ECOWAS Small-Scale Hydro Power Program, managed by:

ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE)
Mr. Mahama Kappiah, Executive Director
Mr. Hannes Bauer, Program Manager

www.ecreee.org

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ABBREVIATIONS

AfDB	African Development Bank
AfP	Agenda for Prosperity
BHP	Bumbuna Hydro Power
DoE	Directorate of Energy
EBRD / BERD	European Bank for Reconstruction and Development
ECOWAS	Economic Community of West African States
ECREEE	ECOWAS Centre for Renewable Energy and Energy Efficiency
EDSA	Electricity Distribution and Supply Authority
EEEP	ECOWAS Energy Efficiency Policy
EGTC	Electricity Generation and Transmission Company
EP	The planned ECREEE Program on upgrading the hydro-meteorological network and database for small-scale hydropower Sierra Leone
EREP	ECOWAS Renewable Energy Policy
EWRC	Electricity and Water Regulatory Commission
FS	Feasibility study
GDP	Gross Domestic Product
GEF / FEM	Global Environment Facility / Fonds Mondial de l'Environnement
GoSL	Government of Sierra Leone
GTI	Government Technical Institute
HFO	Heavy fuel oil
HEP	Hydroelectric power plant
HP	Hydropower plant
IMF / FMI	International Monetary Fund (Fond Monétaire International)
IPP	Independent Power Producers
MoE	Ministry of Energy
MoLCPE	Ministry of Lands, Country Planning and Environment
MWR	Ministry of Water Resources (Sierra Leone)
NREAP	National Renewable Energy Action Plan
NREP	National Renewable Energy Policy
PD	Program Document
SE4ALL	Sustainable Energy for All
PSHD	Preparing for Small Hydropower Development
PSHDP	Preparing for Small Hydropower Development Program
SHP	Small hydropower plant (defined ≤ 30 MW in ECOWAS region)
SREP	Scaling Up Renewable Energy Program
SSHP	Small-Scale Hydropower Program
ToR	Terms of Reference
UNDP / PNUD	United Nations Development Program
UNIDO / ONUDI	United Nations Industrial Development Organization
WAPP	West African Power Pool
WHYCOS	World Hydrological Cycle Observing System
WD	Water Directorate
WMO / OMM	World Meteorological Organisation / Organisation Météorologique Mondiale

PROJECT SYNOPSIS

Project Title	Creating a program document on upgrading the hydro-meteorological network and database for small-scale hydro power Sierra Leone (and as separate program document als for Guinea)	
Country	**Sierra Leone** In parallel also a program document on the same topic based on the needs for small-scale hydropower development in Guinea was developed.	
Overall objective	To support the development of the small- scale hydropower sector by reducing the barriers of insufficient human resources and inadequate networks for collection of hydrological and meteorological data.	
Specific objectives according to TOR	I. To carry out rapid review of relevant literature related to small scale hydropower potential, hydropower development and operational hydrology in ECOWAS region with the main focus on situation in Sierra Leone. II. To carry out field reconnaissance to collect baseline data and information and thereafter together with the ECREEE team to consolidate the overall analysis of the situation, resources, problems, development and training needs for hydrological data collection in the context of SSHP development Sierra Leone. III. To create a program document for the selected countries on creating/upgrading the hydro-meteorological network and database that would serve the needs of small-scale hydro power including the necessary capacity building of local stakeholders.	
Firm executing consulting services	**<u>For Sierra Leone</u>:** HYDRO-CONSULTING dr J.G. PERZYNA Street address: Kordeckiego 14/3 Postal address: PL 01-722 Sopot	**For Guinea:** SKAT Consulting Ltd. Vadianstrasse 42 9000 St. Gallen Switzerland
Contact person and author of the report	Greg Perzyna (Sierra Leone)	Hedi Feibel (Guinea)
Telephone	+48 502549402	+41 71 228 5454
Email	gregwat@3net.pl	hedi.feibel@skat

1 EXECUTIVE SUMMARY

This program document, presents a set of components for scaling up the deployment of small scale renewable hydropower energy and to transform the Sierra Leone electricity subsector from fossil fuel based electrical energy supply to one that uses a more varied supply of renewable energy sources.

The program proposal presents a 4-year timeframe (2016-2019) and an estimated budget of EUR 730,000, with the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECRCREE) as the implementing agency.

Sierra Leone faces major supply challenges of electrical energy. The average Sierra Leone electrification rate is estimated at about 13% (access to electricity from the national power grid). The access to electricity differs greatly between the urban and the rural areas. Less than 1.5% of the rural population have access to electricity in contrast to more than 40% in urban areas.

The program aims to improve the quality and availability of information on Sierra Leones's hydro resources. This information will be essential for developing off-grid small hydropower energy projects in Sierra Leone. The Preparing for Small Hydropower Development Program shall consist of four following components.

Component 1: Practical training in river flow measurements

Component 1 will train participants in techniques of streamflow measurement and discharge calculation methods for potential SHP sites. The training will include theoretical sessions and intensive practical field training on small rivers in the Freetown region.

Component 2: Rising awareness on small hydropower potential in Sierra Leone

Component 2 will include series of workshops raising the awareness of the decision makers on SHP potential and importance of background data (initial assessment) for sustainable SHP development in Sierra Leone.

Component 3: Inventory of potential small hydro power sites.

Component 3 will contribute to the completion of an inventory of most attractive potential SHP sites in Sierra Leone and will facilitate future decisions on introducing hydropower energy in national electricity supply.

Component 4: Upgrading hydrometric network

Component 4 will establish small network of hydrometric stations and hydrological data collection system that will address hydrological data needs of SHP hydropower development

These four components constitute separate work packages but their outputs are inter-related. Intensive on the job training will be an inherent activity of the each of project components.

The Ministry of Energy, Ministry of Water Resources, Fourah Bay College, University of Sierra Leone, Small Hydro Power Technology Centre and Njala University have been identified as the most relevant local program partners.

The major outcomes of the program will be:

1. Increased awareness of decisions makers about a need for careful assessment of small hydropower projects and increased understanding of evaluation and planning process.
2. Improvement of background information for project selection, evaluation, feasibility

studies and design. The risk that less attractive site is developed and better SHP sites may remain unknown will diminish.

3. Technical capacities will be created within MoE, MWR, FBC and other national partners to independently evaluate and carry out an initial assessment of SHP sites.
4. The program will build up institutional capacity of MWR and professional skills of the MWR staff to construct maintain and operate hydrometric network.

This program will be instrumental in promoting private sector participation in SHP development. The collected by program data and the compiled information shall be open and freely available for all users assuring more effective decision making process and SHP development.

The program is in line with the Sierra Leone Agenda for Prosperity and the Sierra Leone National Energy Policy and Strategic Plan which have emphasized that GoSL shall promote the development of small hydro sites and other renewable energy technologies through different arrangements including public/private partnerships.

2 BACKGROUND INFORMATION

2.1 General context of the Program

The Preparing for Small Hydropower Development Program (PSHDP) responds to the priorities and actions identified in the framework of ECOWAS Small-Scale Hydropower Program (SSHP). The SHHP was adopted by the ECOWAS Ministers of Energy in October 2012. The program is managed by the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE).

The overall objective of the SSHP Program is to contribute towards increased access to modern, affordable energy services, energy security as well as mitigation of negative externalities of the energy system by establishing an enabling environment for small-scale hydro power development and investments in the ECOWAS region. The SSHP Program is a priority action under the regional SE4ALL Framework for West Africa.

In Sierra Leone hydropower could partly substitute electricity generation from imported HFO and diesel fuels which are vulnerable to international market price fluctuations and contribute to decarbonisation of energy supply. Small hydropower projects (SHP), with an installed capacity below 10 MW can be the right size to alleviate the forecasted increase in power demand and to increase electricity access in rural areas. The development of SHP sector in Sierra Leone is, however, hindered by lacking information for project's selection. The SHP resources of Sierra Leone have not been systematically assessed and a comprehensive inventory of potential small and mini hydropower sites was never produced. The background information for a sound decision making and SHP design is lacking in many areas, including sites location, topography and hydrology conditions of potential sites.

There is a definite political will in Sierra Leone to strengthen the small scale hydropower sector. The Sierra Leone Agenda for Prosperity (GoSL, 2012) defined hydro-electric power generation as the principal source of electricity with a considerable development potential. The Sierra Leone National Energy Policy and Strategic Plan (2009) emphasised that GoSL shall promote the development of mini/micro hydro sites and other renewable energy technologies through different arrangements including public/private partnerships.

The elaboration of this program document (PD) is based on the findings of the ECREEE scoping Mission which visited Sierra Leone from April 10th to April 15th, 2016. The Mission met and discussed with the key stakeholders about the planned program, its benefits and the modalities of its implementation in Sierra Leone. During the wrap-up meeting, the Mission presented preliminary findings, discussed about the suggested by the key-stakeholders priority activities for the Preparing for Small Hydropower Development (PSHD) Program and presented the proposed phased approach to the program implementation.

2.2 Country background

Republic of Sierra Leone is situated in Western Africa. Sierra Leone has an area of 72,325 km^2. The country is bordered to the northeast by the Republic of Guinea, to the south and southeast by the Republic of Liberia and to the west by the North Atlantic Ocean. The population of the country is about 6.45 million, (World Bank 2016). Freetown, the capital city of Sierra Leone is located in the western area of the country and it has a population of approximately 1 million (~16 % of the total population).

Sierra Leone is considered by the UN classification as a Least Developed Country. In 2002 Sierra Leone emerged from a brutal 11-year civil war with most of its infrastructure including power network destroyed, or in a state of disrepair. The country has achieved relative stability in the post-conflict years and was one of Africa's fastest growing economies. Recently, this development was slowed by the 2014 Ebola epidemics and the closure of the

mining sector due to the decline of international market prices. The Gross Domestic Product (GDP) per capita of Sierra Leone was estimated to be around 680 US$ in 2014 and the country is between the ten poorest countries in Africa.

The country can be divided into four distinct physical regions: the coastal plain, the Sierra Leone Peninsula, the interior plains, the interior plateau and the mountain region. Sierra Leone has a tropical climate which is strongly influenced by the West African Monsoon. The rainy season usually spans from June to November and the dry season spans from December to May. The greatest rainfall is along the coastline.

The country has relatively dense drainage. The Sierra Leone rivers are rain-fed and show a considerable seasonal flow fluctuations. All principal rivers flow from their headwaters in the south-west direction and discharge into the Atlantic Ocean. From north to south the largest rivers are the Great Scarcies, Little Scarcies, Rokel (also called the Seli), Jong, Sewa, Waanje, Moa, and the Mano River. The Great Scarcies and Moa River form portions of the border with Guinea, while the Mano forms much of the country's frontier with Liberia.

2.3 Status of Energy Sector in Sierra Leone

Sierra Leone faces major supply challenges of electrical energy. In 2010, electricity consumption per capita was about 34 kWh (Ministry of Energy 2015), which is one of the lowest rates in Africa and in the world. The average Sierra Leone electrification rate is estimated at about 13% (access to electricity from the national power grid). The access to electricity differs greatly between the urban and the rural areas. Less than 1.5% of the rural population have access to electricity in contrast to more than 40% in urban areas.

Current status of electricity sector. The existing power infrastructure is concentrated in the Western Area region of the country in which Freetown is located. Two isolated systems (Bo-Kenema and Makeni systems) provide coverage in delimited areas in the south-eastern and northern regions. In rural areas, where the majority of the population lives, practically there is no infrastructure.

At the end of 2014, the total installed capacity on the national grid was about 100MW, comprising hydro generation (56MW), thermal (27MW) and biomass (15MW). The transmission and distribution infrastructure is in poor condition resulting in power losses of up to 40%.

The bulk of electricity production comes to date from the thermal heavy fuel oil (HFO) generation in the Freetown area and the Bumbuna Hydroelectric Plant which is located on the Seli River about 200 km northwest of Freetown. Due to the strong seasonal variation of streamflow, the generation of the Bumbuna HPP falls considerably during dry seasons which lead to frequent load shedding in the Western Area region of the country. The 15 MW Addax bioethanol plant in Makeni which was commissioned in 2014 is presently not operational.

Sierra Leone is currently experiencing a net deficit of power with average peak demand requirements of 300-500 MW. The mining sector primarily relies on its own generation. It is estimated that non-mining private customers use currently more than 30,000 diesel generators with capacity of approximately 180 MW. An estimated 10% - 20% annual rate increase in power demand is forecasted in the coming 10 years. Poor access to electricity is recognized as a binding constraint to long-term economic growth in Sierra Leone.

Institutional structure. In recent years the GoSL has devoted extensive efforts into reforming its institutional and regulatory frameworks of the energy and water sectors. In 2011 the Sierra Leone Parliament passed the Sierra Leone Electricity & Water Regulatory Commission Act and the National Electricity Act.

In 2013, the former Ministry of Energy and Water Resources was split into two independent

Ministries: Ministry of Energy (MoE) and Ministry of Water Resources (MWR). In 2014, the GoSL started preparing a new Renewable Energy Policy.

Following the approval of the new national electricity legislation, with support of World Bank, the Government has focused last years on energy sector utility reform. The former National Power Authority (NPA) was split into two entities i.e. the Electricity Generation and Transmission Company (EGTC) and the Electricity Distribution and Supply Authority (EDSA). In 2015, the autonomous Electricity and Water Regulatory Commission (EWRC) was established with a mandate of regulating electricity and water producers and service providers.

The Ministry of Energy was established in 2013 and is the custodian of the electricity sector. At present, Sierra Leone has no independent Rural Electrification Agency. The Directorate of Energy (DoE) is in charge of strategic planning on energy issues and is responsible for introduction and promotion of renewable energy resources. To meet this objective, in 2013, the DoE formed the Renewable Energy and Energy Efficiency and Rural Electrification units. The MoE Planning Unit and the Project Management Unit are responsible for planning and supervision of all energy projects and particularly renewable energy projects.

2.4 Hydropower renewable energy potential and implementation

Sierra Leone is endowed with considerable hydropower resources. The estimated country hydropower potential varies greatly between sources; 1200 MW (Lahmeyer 1996), 2000 MW (MoE, 2015), >5000 MW (UNIDO, 2015). As of 2014 the installed hydropower capacity was about 56 MW which indicates a large development potential. The hydropower supply in Sierra Leone is variable due to large seasonality of rivers discharge.

2.4.1 Government renewable energy policy and strategy:

The importance of hydropower development as a whole and the small scale hydropower in particular had been confirmed by the National Energy Policy and Strategic Plan MEWR (2009) and the Sierra Leone Agenda for Prosperity (GoSL, 2012).

Following the ECREEE regional implementation framework the Ministry of Energy (2015) produced three major documents:

- National Renewable Energy Action Plan (NREAP)
- National Energy Efficiency Action Plan (NEEAP)
- Sustainable Energy For All (SE4ALL) Country Action Agenda

It is the priority of the GoSL to accelerate the expansion of electricity access to the population and improve supply of reliable services essential for economic growth. According to the information from NREAP (2015) and SE4ALL (2015) reports the GoSL has an ambitious strategy to increase electricity access from 12.5% (year 2013) to about 90% nationwide by 2030 including 55% of population connected to national grid, 27% to renewable energy mini grids and 10% of population connected to stand alone renewable energy systems.

2.4.2 Present hydropower generation:

The present hydropower generation comes from three hydropower plants:

1. The medium sized Bambuna HP (50MW) which located at Bumbuna Town in the northern part of Sierra Leone at a distance of some 200 km from Freetown.
2. The small run-of-the river Dodo HP (6MW) located in the Eastern Province, some 380 km from Freetown and 69 km from the headquarter town of Kenema.
3. The mini-hydro Yele HP (0.12 MW) located in Tonkolili District on the Teye River.

Small hydropower plants under construction: Three small hydropower plants are presently being constructed in Sierra Leone. The Bankasoka HP with capacity of 2.2 MW is under construction at Port Loko in Northern Province. The project is supported by the Chinese Government, UNIDO and GoSL. It is the Mission understanding that the Bankasoka will work in a hybrid system to compensate for streamflow seasonality and to secure electricity supply during the dry season.

Two small hydro plants are also currently under construction based on the grant agreement with Chinese Government. The 2.2 MW HPP in the Charlotte Village in Rural Freetown has been nearly 90% completed and it is expected to be commissioned in the second part of 2016. Also the 0.5 MW Makalie plant in the Tonkolili District should be commissioned this year.

Planned SHP's: A well-advanced plan exists for the construction of a SHP with capacity of 10 MW in the Moyamba District in the South Province of Sierra Leone. The studies are nearly completed and the project implementation may begin soon. The Moyamba HPP will mainly supply electricity for the downtown of Moyamba District and NJALA University. There are also plans to upgrade the working Dodo SHP with an installed capacity of 6 MW to 12 MW capacity.

It is highly probable that, in the near future, the commenced Scaling-up Renewable Energy Program (SREP) will bring a substantial economic support to the development of new on-grid and off-grid small and mini-hydro plants in Sierra Leone.

2.5 Barriers to small scale hydropower development in Sierra Leone

A considerable share of electricity demand in Sierra Leone could be met by hydropower energy, but current policies, strategies and prevailing barriers delay development of this type of energy generation. The majority of the barriers hindering small hydropower development in Sierra Leone are not unique to hydropower sector but are universal for all types of renewable energy projects in developing economies. These general barriers include:

- Uncertain policy, legal and regulatory environment.
- Institutional constrains.
- Limited available state budget to create an enabling environment for mobilising resources and encouraging private sector investment.
- Lack of access to capital, financing and difficulty in attracting investors and financiers.
- Limited affordability - limited ability to pay for electricity connections and consumption under traditional billing arrangements (the absence of clear policies on renewable energy.
- Limited technical capacity to plan, build and operate hydropower plants.

The PSHD Program shall make a concentrated effort to address four specific and highly prevalent barriers which impede the SHP development in Sierra Leone. These are:

1. **Insufficient awareness of small scale hydropower benefits**

   The level of awareness about the potential for small-scale hydropower development and benefits of small hydropower generation is not sufficient among many institutions and decision-makers in Sierra Leone. As a consequence conventional energy sources are often prioritized where the potential for hydropower development exists.

   To enhance the uptake of small and mini hydro technology local stakeholders need to be made aware of the opportunities for the technology. The public awareness on implications of global warming and the awareness that every country is responsible to reduce its CO2 emission is still lacking.

2. Limited human capacity to investigate and plan SHP hydropower plants

Emerging from the civil war, which destroyed much of the existing institutions, infrastructure and displaced many people, Sierra Leone is faced with severely depleted human and institutional capacity. The limited technical capacity of the MoE and MWR is one of the major constraints to SHP development. The MoE and Department of Energy are specifically lacking capacity:

- to undertake site investigation, assessment and to complete inventory of potential SHP sites
- to carry out pre-feasibility and feasibility studies of SHP projects
- to evaluate quality and result of studies carried out by external consultants
- to select/ indicate economically most viable SHP projects

The MWR have virtually no competence in the field of operational hydrology and is lacking technical capacity:

- to operate and maintain hydrometric equipment/instruments
- to undertake flow measurements at potential hydropower sites
- to construct, equip and maintain hydrometric stations
- to operate hydrological data collection system

3. Limited information on potential SHP sites

The SHP resources of Sierra Leone have not been systematically mapped and assessed. A comprehensive inventory of the potential small, mini and pico hydropower sites was never produced. The most cited and referred list of some 30 potential hydropower sites was compiled by Lahmeyer (1996) more than 20 years ago. This Consultant concentrated mainly on the assessment of hydropower potential of larger sites with capacity of more than 2MW and Lahmeyer's inventory includes only two sites with potential capacity of less than 5MW.

The recent desk study of hydropower potential in Sierra Leone (UNIDO 2013) identified a large number of potential hydropower sites including "269 run-of-the-rivers, 39 river falls and 18 lakes sites". This inventory do not contain, however, any description of a methodology approach that was used for the assessment of hydropower potential as well as data on available head and flow rates.

Access to the historical hard copy reports and detailed information is today limited and some of the consultants, as in the case of the recent HydroChina Corporation (2012) hydropower resources study, are not willing to share detailed information and results.

4. Scarcity of hydrological data and lacking system of data collection

There is a limited awareness and failure to realize how important hydrological field data for a proper design of small hydropower plants are. Over the past decade, there have been many instances in Africa where the performance of new small hydro developments has been compromised by wrong design of power plants associated with lacking field data.

Hydrological data in Sierra Leone are scarce and unreliable. Much of historical data were lost during the Civil War. The compiled data base does not contain any water level and flow records for the period of more than thirty years from 1976 to 2009. Due to the large seasonality of streamflow in Sierra Leone, it is even more important to build over time a database of hydrological data which can provide the basis for significant statistical analysis.

Lacking and insufficient data imply a high hydrological risk of SHP investments and can seriously constrain the planning and design of hydropower projects in Sierra Leone. In the short term, data scarcity will mean that the estimates of hydropower generation and determination of most economical plant size will be less accurate, than would normally be possible and desired.

According to the established policy the Ministry of Water Resources has the responsibility to collect, archive and publish hydrometric data. However, the national hydrological network and hydrological data collection system in Sierra Leone are not operational at the moment. A separate hydrological department (hydrometric unit), as foreseen in the accepted policy, was not yet established within the MWR and no hydrological services are provided to the users.

2.6 Lessons learned reflected in the program design

- This proposed PSHD Program builds on lessons learnt from the previous renewable energy and small hydropower development projects. Following lessons learnt are reflected in the program design:
- Many previous programs related to small hydropower development had too far-out objectives, too many activities and too comprehensive design. Given the prevalent lack of technical capacity and experience on SSHP, it is important to set realistic targets for the ECREEE programme.
- Many small hydropower related programs and projects were technology driven, result oriented and focused on meeting donor demands. Many projects used entirely expatriate professionals to execute work tasks and didn't focus enough on transfer of knowledge, practices and skills to local counterparts.
- Many projects dealing with assessment of SHP potential didn't include practical on-the-job training component and didn't enhance local knowledge on field reconnaissance, surveying and initial assessment of small hydropower resources. In the long-term local experts should be in better position that their foreign counterparts to interpret and assess local SHP conditions and provide some safeguarding to ensure proper use of results.
- The success of any project depends almost completely on the motivation, capabilities and capacities of the individual staff working on the projects. Therefore, roles and responsibilities of all the project partners on both sides must be clearly identified before the PSHDP start. The availability of the work resources for the PSHDP should be confirmed by the highest managerial level of stakeholders.
- Experience has taught that an adequate capacity of all stakeholders is an essential ingredient for the success of SHP projects. Overestimation of the available technical capacity of stakeholders can cause program failure. Therefore, the implementation of the PSHDP should be preceded by re-examination of inherent capacity of stakeholder's staff to be involved into work with different program components and identification of proper steps to enhance these capacities.
- Lack of accurate background design data for the identified SHP potential sites is one of the major reasons for malfunctioning of SHP systems in Africa. The quality of project selection and evaluation studies is in many cases insufficient. Basic data needed for a project evaluation (maps, surveys, hydrology, and geology) is often missing or difficult to obtain. As a result some attractive sites may remain undeveloped, because information about their location and potential is missing.
- Sierra Leone does not have a comprehensive inventory of potential small and mini hydropower sites with names, their locations as well as information about available heads and flow rates. There is a need for hydropower resources mapping in order to establish and verify the country's SHP potential.

- Experience has shown that individual training targeting specific institutions is not necessarily most effective. Frequently, trained staff is quitting for other jobs and is not able to utilise their newly acquired knowledge. Institutions have not defined career paths and are not set-up to take onboard the upgraded skills.

Lessons learnt from rehabilitation of National Hydrometric Network and Database in the Sierra Leone's neighbour country Liberia. For nearly 30 years, since late eighties, the Liberian Hydrological Service (LHS) did not measure or collect any meteorological and hydrological data in Liberia. Launched in 2011, five years long, the Norwegian/NVE program on upgrading hydro-meteorological network and data base, has changed fundamentally this situation. The major lessons learn from the program are presented below:

- There was and still is a low awareness about importance of hydrological and meteorological data within the ministries and governmental agencies. With the boosting up number of planned hydropower projects, agriculture, road construction, water supply, industrial water supply and waste discharge projects the need for hydro-meteorological data and information rapidly increases. Frequently, this need cannot be met due to the scarcity of hydrological data and deficient data collection systems.
- Collection of hydro-meteorological information is given a very low priority in developing countries. Many countries experience insufficient budgetary allocations to operate their hydrometric networks and as a result degradation of these networks. The ultimate use of hydrological data is often not foreseen. Decision-makers and the public are generally unaware of the overall socioeconomic befits of hydro-meteorological data for hydropower development.
- Experience gained through the implementation of the project clearly shows that a single project of duration of 4-5 years is far from being enough to create sustainable data observing and management capacities.
- The project has been particularly successful in building the technical capacity and skills of the LHS employees through a focus on on-the-job training. The assignment of long-term advisor was a rewarding approach that allowed for a personalized support and tailor-made training of the LHS team members which lacked former hydrological background. The trained staff has had immediate opportunities to use and reinforce the training they receive in daily job tasks.
- A deliberate selection of relatively low-tech equipment for data recording at field hydrometric stations and the state-of the art instruments for streamflow gauging proved to be a right decision. Simple, traditional equipment deployed in the field is durable and has limited maintenance requirements. Technologically advanced equipment used for streamflow gauging allowed to speed up derivation of rating curves for LHS stations so that high quality flow series could be made available to users.
- The project established manual hydrometric data recording system at the stations and employed local gauge readers/observers. This participatory mode of work instilled trust and goodwill amongst local communities, minimized equipment vandalism and contributed to a better understanding among the communities of the purpose for hydrological data collection.

3 THE PROGRAM

3.1 Overall program rationale

The PSHD Program has been designed to assist Sierra Leone in scaling up the deployment of small scale renewable hydropower energy and to transform the country's electricity subsector from fossil fuel based electrical energy supply to one that uses a more varied supply of renewable energy sources. The program aims to improve the quality and availability of information on Sierra Leones's small hydro resources. This information will be essential for developing off-grid small hydropower energy projects in Sierra Leone. Intensive training will be an inherent activity of each project component.

3.2 Programme Development Process

This PSHD program document has been prepared in an iterative process between the ECREEE and partners in Sierra Leone. Fact-finding and Formulation Mission that took place from April 10th to April 15th, 2016 hold extensive meetings and discussions with key players in the renewable energy sector namely the MoE, the MWR and representatives of universities. The Mission openly discussed with stakeholders the main constraints slowing down the development of small scale hydropower in Sierra Leone. Following the discussions on individual barriers the parties agreed that the PSHDP should concentrate on alleviation of barriers arising from the lacking information on geographic location of potential hydropower sites, sites topography, scarcity of hydrological data for evaluation of small hydropower potential and existing human resources gaps that hinder scaling-up investments into clean hydropower energy. The priorities of the principal stakeholders for the planned PSHDP are summarized below:

- The PSHDP should have a small number realistic targets leading to improved data base for SHP development
- Each program component should have a clearly specified one local lead partner
- Taking into consideration limited technical capacity and experience on SHP in Sierra Leone, the fundamental principle of the PSHDP should be to implement participatory approach involving from the start local staff and experts in implementation of the program components
- Activities planned by PSHDP should contribute to long lasting leverage of the practical technical capacity and skills of the partner's employees.
- The PSHDP should substantially improve local knowledge on field reconnaissance of potential hydropower sites and should include a strong practical on-the-job training.
- The PSHDP should help to re-establish a system of hydrological-streamflow data collection which is prerequisite for a proper design of SHP.
- The long-term objective of the PSHDP should be to build up a local team of SHP experts.
- The program training components should follow the principle of "training of trainers".
- Trainings and capacity building activities should be linked to the development of appropriate guidelines and manuals that could be used in curriculum of the Universities
- The prepared training documents should fit to the local conditions and the level of understanding of the respective target groups. Educational institutions/universities in Sierra Leone already include renewables in their curricula and these institutions should be integrated in the planned activities so acquired knowledge could be retained and transferred. Proposed interventions for the program and principal stakeholders

3.2.1 Proposed interventions

Based on the analysis of gathered information and priorities of the Sierra Leone's stakeholders it has been decided and agreed that the PSHD Program shall consist of four following components.

Component 1: Practical training in river flow measurements

Component 1 will train participants in techniques of streamflow measurement and discharge calculation methods for potential SHP sites. The training will include theoretical sessions and intensive practical field training on small rivers in the Freetown region.

Component 2: Rising awareness on small hydropower potential in Sierra Leone

Component 2 will include series of workshops raising the awareness of the decision makers on SHP potential and importance of background data (initial assessment) for sustainable SHP development in Sierra Leone.

Component 3: Inventory of potential small hydro power sites.

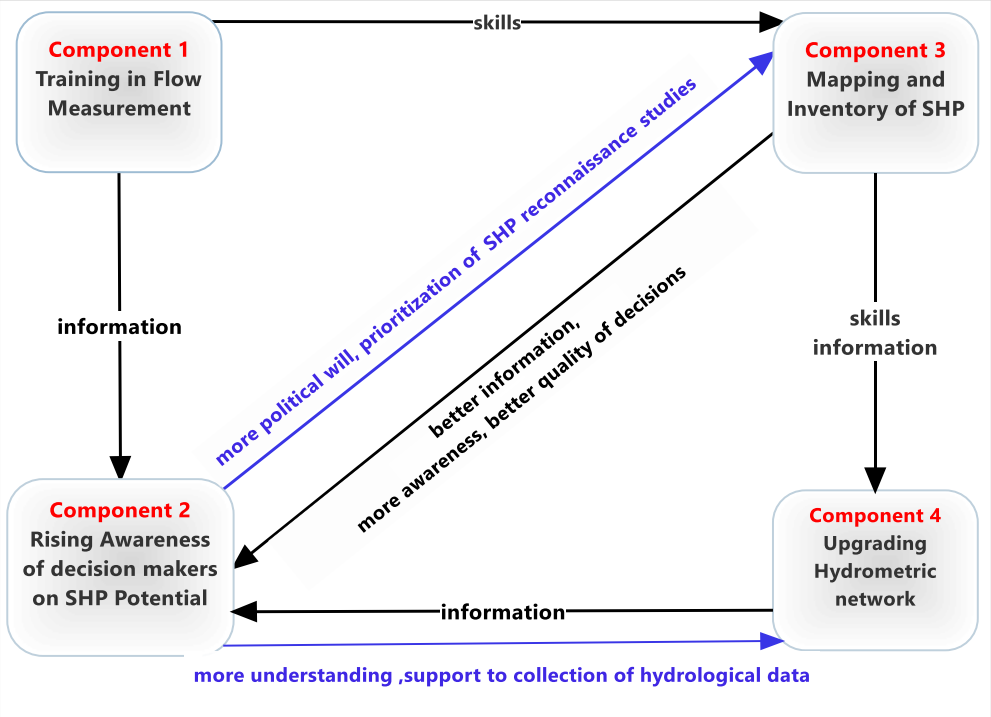
Component 3 will contribute to the completion of an inventory of most attractive potential SHP sites in Sierra Leone and will facilitate future decisions on introducing hydropower energy in national electricity supply.

Component 4: Upgrading hydrometric network

Component 4 will establish small network of hydrometric stations and hydrological data collection system that will address hydrological data needs of SHP hydropower development

These four components constitute separate work packages but their outputs are inter-related (See Figure 3-1).

Figure 3-1 Inter-relations between the program components



3.2.2 Principal local implementing partners (stakeholders)

The Ministry of Energy, Ministry of Water Resources, Fourah Bay College, University of Sierra Leone, Small Hydro Power Technology Centre and Njala University have been identified as the most relevant local partners. In practice, these stakeholders will be engaged

into implementation and execution of all program components. Their function and type of engagement are summarized in Table 3-1.

Table 3-1 Involvement of principal local partners/stakeholders in implementation of the program components

Stakeholder	Component 1	Component 2	Component 3	Component 4
Ministry of Energy	P	**L**,I,P	**L**,I,P	P
Ministry of Water Resources	P	P	P	**L**,I,P
Fourah Bay College, University of Sierra Leone and Small Hydro Power Technology Centre	**L**,I,P	P, I	I,P	P,
Njala University	P	P	P	

L - stakeholder responsible for taking the local lead in performing component tasks
I - stakeholder has to be involved in the component work stream (staff/experts)
P - participants from stakeholder institution (observer, trainee)

Ministry of Energy – Directorate of Energy: The Ministry of Energy was established in 2013 and it is the custodian of the electricity sector. At present, Sierra Leone has no independent Rural Electrification Agency. The Directorate of Energy (DoE) of MoE is in charge of strategic planning on energy issues and is responsible for introduction and promotion of renewable energy resources. To meet this objective, in 2013, the DoE formed the Renewable Energy and Energy Efficiency and Rural Electrification units. The MoE Planning Unit and the Project Management Unit are responsible for planning and supervision of all energy projects and particularly renewable energy projects. In recent years, the DoE has already successfully implemented several donor funded renewable energy projects.

Ministry of Water Resources: The Ministry of Water Resources (MWR) was established in 2013 with responsibility for water policy formulation and water sector. The MWR has the mandate to manage and safeguard water resources at local, national and transboundary level in Sierra Leone. The Water Directorate (WD) of MWR has oversight over water sector agencies and is the focal point for coordination of the drinking water supply and water-related sanitation. According to the established policy the MWR has the responsibility to collect, do quality controls, and archive and publish hydrometric data from gauging station networks across Sierra Leone. A new governance structure for the water sector is presently being implemented. In 2016 the National Water Resources Management Agency (NWRMA) should be established. The NWRMA's will have mainly regulatory functions. It is proposed, however, that the Agency will take over responsibility for hydrological data collection in in Sierra Leone.

Fourah Bay College at University of Sierra Leone and Small Hydro Power Technology Centre: The FBC is the oldest university in West Africa and its Faculty of Engineering has educated majority of the engineering staff working presently in governmental and private institutions. Several senior members of the FBC staff have competence in water resources, water balance, water supply and drainage structures topics. It is worth mentioning that FBC personal is engaged in numerous consulting activities within the renewable energy sector. In 2014, with support of UNIDO, the Fourah Bay College established the Small-Hydro Power Technology Centre (SHPTC). The objective of the Centre is to promote clean energy innovation and to provide relevant theoretical and practical base for student's development in the field of small-hydro power. The centre is equipped with more than $100,000 worth survey and hydrometric equipment. The equipment is primarily meant to be used for practical training of students but also for field studies of potential SHP. The Centre has good facilities

and outstanding links with the Fourah Bay College teaching staff.

SHPTC offers the graduate programme in energy studies. Six students are currently following MPhil degrees in various RETs and 2 students are in the enrolment process for PhD degrees in hydropower.

Njala University: the university offers the BS program in energy studies and the master studies in renewable energy and the environment. In the course of studies students receive theoretical training. The study curriculum prioritizes solar systems. The university is lacking laboratories and practical training facilities.

4 COMPONENT 1: PRACTICAL TRAINING IN RIVER FLOW MEASUREMENTS

4.1 Component rationale

The overall objective of the component 1 is to facilitate the development, planning and assessment of SHP in Sierra Leone and to reduce the barriers to small scale hydropower development related to lacking capacity to measure flow at potential SHP sites.

The intensive two weeks long training aims to assist the Sierra Leone's partners and training participants to:

1. Acquire basic understanding about working mechanism of small hydro generation,
2. Assimilate the concept of flow and head - two most important parameters associated with a hydropower plant output,
3. Receive intensive practical field training in river flow measurements by the current meter technique. This is aimed at developing the ability of participants to transfer knowledge and skills (training of trainers).

4.2 Main output and outcomes

The immediate main output from the Component 1 will be a group of 16 participants from MoE, MWR, FBC and other countries in West Africa trained and able to perform discharge measurements at potential SHP sites.

The training will enhance capacity of local counterparts and institutions in hydrometry. The training will increase knowledge and awareness on the need for initial assessment of small hydro potential as well as about importance of field data.

The intended spill over effect of the Component 1 should be the inclusion of the training course in river discharge measurement into curriculum of FBC allowing for the knowledge retention and replication of training in Sierra Leone.

4.3 Mode of implementation

Implementation of the hydrometry training package is planned for the autumn 2016 with a two weeks training exercise in Freetown that will be conducted in late October or November.

The training will be open for participants from Sierra Leone such as the staff of MWR, MoE, FBC, Njala University, SHPTC and from other ECOWAS countries with similar training needs (max 16 persons).The local institutions will be responsible for selection of candidates for training in accordance with criteria set down by ECREEE.

ECREEE intends to liaise with Small-Hydro Power Technology Centre (SHPTC) and Fourah Bay College, University of Sierra Leone. These two local institutions will have a lead role in organizing the training.

An instructor trainer with (technical consultant) will be commissioned by ECREEE to supervise and conduct a theoretical part of training course. The instructor shall have an extensive practical experience in SHP design and especially in hydrometry training. The Consultant will be responsible for production of the training aids and manuals.

ECREEE will use synergy with the Norwegian Hydrometry Programme carried out in Liberia and intends to use the trainers from Liberian Hydrological Service to carry out field training exercises. This should imply high levels of trust and good communication between participants and trainers. Through use of local Liberian instructors the trainees will be able to appreciate and recognize the value of training as a way towards career progression.

The largest part of the training will be a practical training in flow measurement that will take place in the field at suitable river sites.

The prepared training manuals will fit to the local conditions and can be incorporated later into the curriculum of the Fourah Bay College, University of Sierra Leone. This would guarantee retaining and transferring the acquired knowledge further. The tentative program of the training include following topics:

- Basics of hydropower generation
- Objectives and survey items for reconnaissance of SHP sites
- Concept of available flow and head
- Principles and methods of discharge measurement
- Introductory, field training in measurement of head
- Intensive practical field training discharge measurement by the current meter technique.
- Calculation of discharge

The expected outputs, outcomes and respective indicators for the Component 1 are summarized in the result matrix shown in the next paragraph.

4.4 Result Matrix - Component 1

Component 1: Practical Training in River Flow Measurements			
Lead Partner	Fourah Bay College, University of Sierra Leone and Small Hydro Power Technology Centre	**Partners**	ECREEE, MWR, MoE, Njala University
Participants	Participants from Sierra Leone such as staff of MWR, MoE, and FBC and from further ECOWAS countries with similar training needs(max 16 persons)		

Input/Resources	**Activity**	**Output**	**Outcome**
Inputs to be provided by ECREEE: • Administrative and technical support services • Funding support of ECREEE • External technical assistance – international expertise • Training aids, manuals • Regional Liberian trainers • Hydrometric equipment Inputs to be provided by partners • Supporting staff • Workshop training room, projector • Identification and clearing of field sites for measurements • Logistic support: transportation, lodging, food • Hydrometric equipment	Theoretical Training Basics of hydropower generation Objectives and survey items of site reconnaissance Concept of available flow , flow duration and head Principles and methods of head measurement Principles and methods of discharge measurement Field training: Introductory, brief training in measurement of head Intensive practical field training discharge measurement by current meter technique. Calculation of discharge	Participants will have a good knowledge of energy conversion principle Participants familiar with objectives for reconnaissance survey of potential SHP Participants familiar with methods of head measurement Participants will have a good theoretical background in streamflow measurement techniques with focus on current meter equipment and area velocity method of discharge measurement Training participant familiar with basic levelling technique Training participants able to act as trainers in discharge measurements by area velocity method with help of current meter technique Participants able to calculate river discharge based on discharge measurement results	Increased knowledge and awareness on the need for reconnaissance and basic assessment of small hydro potential Increased awareness about need for field data Increased professional capacity and competence of Sierra Leone's trainees in hydrometry FBC able to carry out student courses in discharge measurement by area- velocity method and to replicate training in Sierra Leone

Indicators
Number of participants trained Number of participants passing certification test Training incorporated into curriculum of FBC

5 COMPONENT 2: RISING AWARENESS ON SMALL HYDROPOWER POTENTIAL IN SIERRA LEONE

5.1 Component rationale

The overall objective of the component 2 is to raise the awareness of the decision makers on the SHP potential in Sierra Leone and the potential of small hydro for off grid rural electrification. The Component 2 shall enhance the knowledge of decision makers about the general concept of hydropower generation. The Component 2 shall make aware the Sierra Leone decision makers on the hampering effect which lacking basic information has on evaluation, verification, ranking, design and development of potential SHP projects in Sierra Leone.

The goal for the Component 2 is to prepare and conduct three workshops for the Sierra Leone's decision makers and other stakeholders over the period 2016-2017. The concentrated 1-day sessions will aim to raise awareness about:

1. General concepts of SHP generation; flow, head, electricity.
2. SHP as a clean, sustainable and emissions-free source of renewable energy, off grid systems, rural electrification.
3. Risks for superficial design and unfortunate choice of SHP projects without initial assessment SHP potential in Sierra Leone – value of the SHP inventory.

5.2 Main outputs and outcomes

The main output from the Component 2 will be series of 1-day long, concentrated awareness rising sessions (workshops). Educating people about the SHP potential and winning the hearts and minds of policy makers is a key to the successful development of SHP in Sierra Leone.

The Component 2 will promote awareness about small hydropower as an environmentally sustainable and emissions-free source our renewable energy mix.

The long-term outcome of the planned workshops will be an increased awareness of decisions makers and other professionals about a need for careful assessment of SHP projects and increased understanding of evaluation and planning process. The participants will familiarize with the fact that premature decisions about SHP project's implementation, not preceded by a detailed analysis of at site hydrological conditions, may lead to a wrong design and malfunction of equipment in the future.

The improved awareness between government bodies and donors about importance of at site data for SHP design and a need for collection of hydrological information should help to establish and sustain the hydrological information system (hydrometric network) in Sierra Leone.

5.3 Mode of implementation

A Technical Consultant will be commissioned by ECREEE to prepare detailed workshop programs, aids and to act as key speaker/trainer. The Consultant will liaise and coordinate the input from featured Sierra Leone's speakers, selected to present a snapshot of local barriers, challenges and opportunities for SHP development.

The workshops will explore potential and challenges for SHP development in Sierra Leone. They will be tailored to meet the needs of policy decision makers, government agencies, experts from universities and organisations linked to SHP development in Sierra Leone.

Tentatively the Component 2 should run three 1-day long workshops in Freetown with the following targets audience:

Workshop 1: highest level decision makers and planning officers from State House, Office of President SL, MoE, EGTC, EDSA, EWRC, MWR involved in formulating and applying planning policies for SHP renewable energy projects in Sierra Leone. The donors will be invited to participate.

Workshop 2: management and technical staff from ministries, professionals from universities, private sector, potential hydropower investors, mining sector and non-governmental organization

Workshop 3: will be designed to bring together a combined audience from the first two workshops

The workshops 1 and 2 will have a similar content, but adapted to different audience, tentatively focusing on:

- General concept of hydropower generation and energy transformation
- SHP as clean, sustainable and emissions-free source of renewable energy suitable for off grid rural electrification
- Hampering effect of lacking basic information (location, hydrology, topography) on evaluation, verification, ranking, design and development of potential SHP projects in Sierra Leone.
- Benefits of desk studies, field reconnaissance, survey of sites topography and long term hydrological data collection for SHP planning and finding potential investors or donors
- Seasonality of SHP generation potential in Sierra Leone – concept of hybrid renewable energy systems

The workshop 3 is meant as a brainstorming session on SHP development in Sierra Leone bridging the difficult gaps between policy makers and practitioners. The discussion will be led by a moderator and can focus on following topics:

- Assessment of present situation, prevalent barriers and mitigation actions
- Institutional arrangements required to develop and successfully implement SHP.
- Is a strong central coordinating body important for ensuring effective implementation of renewable energy and SHP efforts and initiatives?
- Should one institution take the lead role in coordination of all SHP projects being implemented and planned?
- How to finance and secure uninterrupted operation of hydrological monitoring network?
- SL Universities as centres of local capacity building for renewable energy/SHP projects in Sierra Leone
- How to attract donors and coordinate donors support to SHP development processes in the most effective way?

The detailed workshops program prepared by the Consultant will be verified by ECREEE and local partners in order to take into account specific needs and priorities of stakeholders.

The workshops aids/presentations should be prepared in a communications-friendly, non-technical way and should include clear and good examples, cases, and recommendations for future SHP planning and development activities.

The expected outputs, outcomes and respective indicators for the Component 2 are summarized in the result matrix shown in the paragraph 5.4.

5.4 Result Matrix - Component 2

<table>
<tr><td colspan="4">Component 2: Rising Awareness on Small Hydropower Potential in Sierra Leone</td></tr>
<tr><td>Lead Partner</td><td>Ministry of Energy</td><td>Partners</td><td>ECREEE, MWR, MoE, FBC</td></tr>
<tr><td>Participants</td><td colspan="3">Workshop 1: Possible highest level representatives of Government, Ministries and donors
Workshop 2: Professionals and representatives of potential hydropower investors, mining sector and non-governmental organization
Workshop 3: Combined audience from the first two workshops</td></tr>
<tr><td>Input/Resources</td><td>Activity</td><td>Output</td><td>Outcome</td></tr>
<tr><td>Inputs to be provided by ECREEE:
• Administrative and technical support services
• Funding support of ECREEE
• External technical assistance – international expert
• Training aids, presentation

Inputs to be provided by partners
• Presentations by local professionals
• Workshop venue
• Logistics</td><td>Organize two workshops focusing on:
SHP as clean, sustainable and emissions-free source of renewable energy suitable for off grid rural electrification
General concept of hydropower generation and energy transformation
Risks of SHP evaluation and choice of a project site without initial assessment SHP potential
SHP design - benefits of field reconnaissance, survey of sites topography and long term hydrological data collection
Seasonality of SHP generation potential in Sierra Leone – use oh hybrid renewable energy systems
Organize 1 workshop bridging the gaps between policy makers and practitioners</td><td>1 day workshop for national policy decision makers and donors
1 day workshop for management and technical staff from ministries , private sector, including professionals, potential hydropower investors, mining sector and non-governmental organization
1 day workshop for the combined audience from the first two workshops</td><td>Risen awareness about small hydropower as an environmentally sustainable and emissions-free source of renewable energy
Increased knowledge about risks of SHP project implementation without initial assessment of SHP sites in Sierra Leone
More awareness about the need for the country-wide inventory of potential SHP sites and for collection of hydrological information
More support to monitoring networks and data collection</td></tr>
<tr><td colspan="4">Indicators</td></tr>
<tr><td colspan="4">Number of participants
Number of workshops
Change of attitude between decision makers toward SHP development process</td></tr>
</table>

6 COMPONENT 3: INVENTORY OF POTENTIAL SMALL HYDRO POWER SITES

6.1 Component rationale

The overall objective of the component 3 is to facilitate the development, planning and assessment of SHP in Sierra Leone and to reduce the barriers to small scale hydropower development related to insufficient information about potential SHP sites.

The implementation of the Component 3 should start in January 2017. Dependent of the progress of the field work assessment phase, the project will last over 18 months. The Component 3 is aiming to:

1. Compile an inventory of potential SHP sites (smaller than 5MW) in Sierra Leone that will constitute the baseline for further investigations, evaluations and verification purposes.

2. Deliver the initial data needed to analyse, assess and plan the SHP development on national, regional and local scales, as well as in support of feasibility studies for SHP projects.

3. Develop the local technical capacity in Sierra Leone for an initial assessment of hydropower sites including the streamflow and head assessment methods and tools. The focus on training can help to increase the likelihood of success of the SHP development in Sierra Leone.

6.2 Main outputs and outcomes

The immediate main output from the Component 2 will be the inventory of potential SHP sites in Sierra Leone providing easily accessible information for all users fostering more effective SHP development. The inventory (data base) will include following site specific data:

- basic topography (head),
- hydrologic assessment
- photo documentation
- dry season measured discharge
- ArcGis layer

Secondly, a group of Sierra Leonean professionals coming from the principal institutions working with renewable energy issues will be trained to independently carry out an initial assessment of SHP sites.

The SHP resource mapping will help to scale up SHP investments in Sierra Leone. The government authorities will be better informed about SHP potential and donors will have a clearer sense of SHP development opportunities.

The Component 3 shall considerably reduce uncertainty of background information for project selection, evaluation and feasibility studies in Sierra Leone. The risk that less attractive site is studied/developed and better SHP sites may remain unknown will diminish.

The training will enhance capacity of local counterparts and institutions. It will raise awareness about the need and benefits of basic assessment of small hydro potential as well as about importance and benefits of hydrological data.

6.3 Mode of implementation

Component 3 is a complete project on its own that partly builds on the foundation created by the Component 1. A detailed Terms of Reference have to be developed prior to the project start. Implementation of the SHP inventory project is planned for a period of 18 month, starting

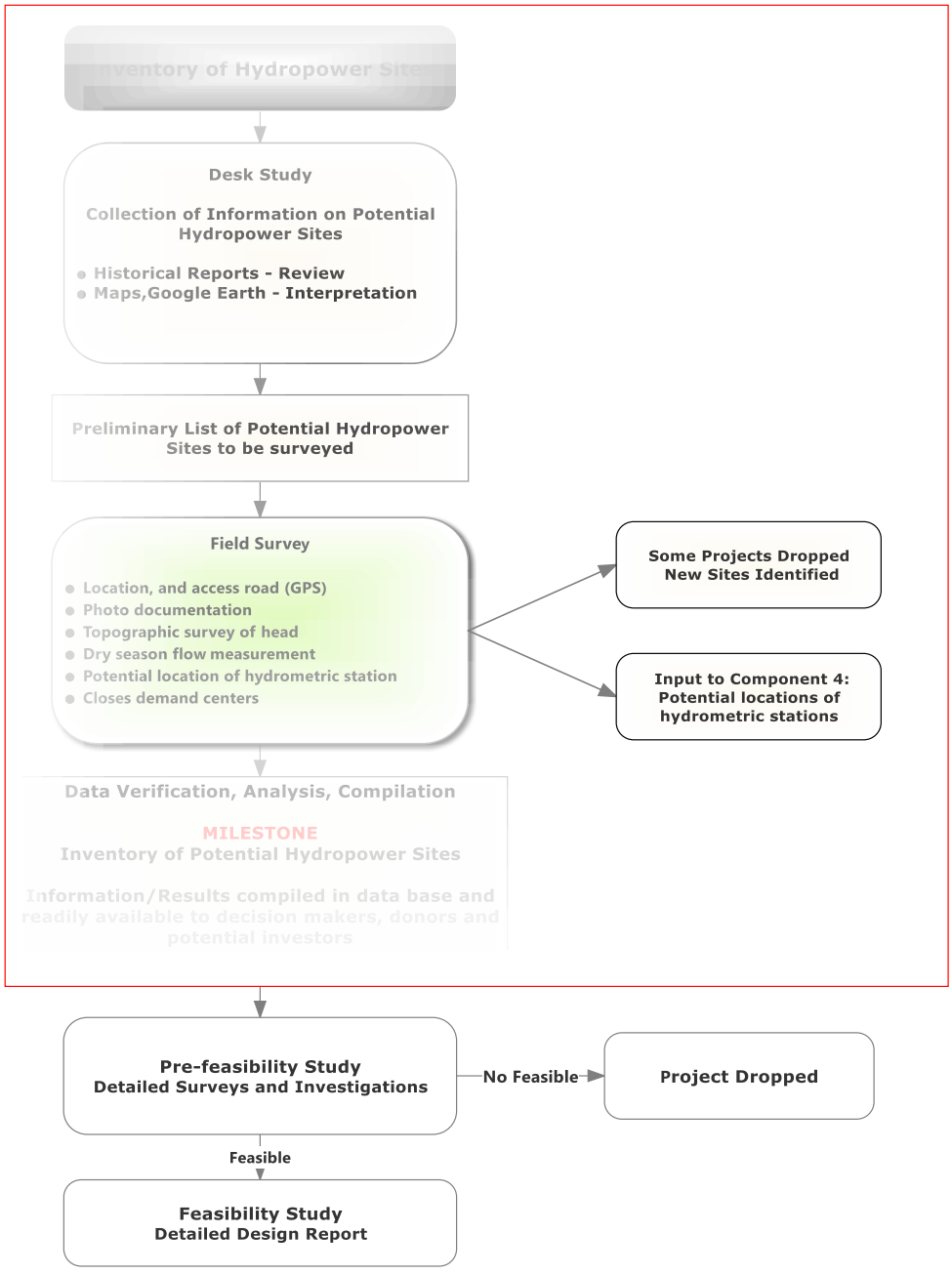
in January 2017.

The project will be implemented by a commissioned Consultant in partnership with local stakeholders.

The Consultant will have overall responsibility for the delivery of the expected outputs. The MoE will have a lead role in coordinating the activities in Sierra Leone.

The project will be executed in three phases. The first phase will focus on a desk study of potential SHP sites. The second phase will concentrate on verification in the field results yielded by the performed desk study including an assessment of available head and dry season discharge for each site. The third phase will focus on compilation and evaluation of the gathered information. The final output of this phase will be an inventory of SHP sites in Sierra Leone. The SHP planning process is illustrated in Figure 6-1.

Figure 6-1 Small hydropower planning process



The assumption is that separate teams of local professional and experts will be established for each phase. Tentatively, the desk study team will consist of 6 local professionals; MoE (2), MWR (1), FBC (2), MoLCPE (1). It is assumed that FBC will provide a GIS/map expert and MoLCPE will provide satellite images expert. The FBC will be responsible for the coordination and of the desk study in Sierra Leone.

Tentatively the field reconnaissance team will consist of 8 local professionals; MoE (3), MWR (3), FBC (2) and will be coordinated and supervised by the MoE.

This type of project arrangement implies cooperation between the technical Consultant and the local partners in a manner that shares risks, responsibilities, resources, competencies and involves a joint commitment to common tasks and goals. Prior to project start, the availability of the work resources (professionals) shall be confirmed by the highest managerial level of partners.

It is assumed that at each stage the project will include a strong practical on-the-job training which should leverage local knowledge and skills. This training should develop the local technical capacity in Sierra Leone for an initial assessment of small hydropower sites

The Consultant should use a simple/practical approach that will allow for a personalized support and tailor-made training of the team members who in majority lack hydrological background and capacity in field reconnaissance, surveying and assessment of small hydropower resources.

The expected outputs, outcomes and respective indicators for the Component 2 are summarized in the result matrix shown in the paragraph 6.4.

6.4 Result Matrix

<table>
<tr><td colspan="4">Component 3 – Inventory of Potential Small Hydro Power Sites</td></tr>
<tr><td>Lead Partner</td><td>Ministry of Energy</td><td>Partners</td><td>FBC MWR, MoLCPE, ECREE,</td></tr>
<tr><td>Participants</td><td colspan="3">Desk study: team of 6 specialists from MoE, MoLCPE, MWR,and FBC
Field study: team of 8 –staff from MoE, MWR, FBC</td></tr>
<tr><td>Input/Resources</td><td>Activity</td><td>Output</td><td>Outcome</td></tr>
<tr><td>Inputs to be provided by ECREEE:
• Administrative and technical support services
• Funding support of ECREEE
• External technical assistance – international expert
• Training aids, manuals
• Procurement of equipment

Inputs to be provided by partners
• Team staff – allocated time
• Office space
• Data sources and maps
• Logistic support: transportation,</td><td>Desk study identification of potential hydropower sites
Verification of SHP site location in the field
Topographic survey of available head for each site
Dry season flow measurements at each site
Suitability of site for locating of hydrometric station
At each stage - on-the-job training of the team
Compilation of data base</td><td>Inventory of potential hydropower sites presented as a soft copy report. The inventory will include:
– basic topography (head),
– hydrologic assessment
– photo documentation
– dry season measured discharge
– ArcGis layer

Team members trained and ready on its own to carry out initial assessment of the potential SHP site.

Preliminary information about potential location of hydrometric stations</td><td>Knowledge and awareness increased on SHP renewable energy

Reduced uncertainty of background information for future hydropower studies

Technical capacities have been created within MoE, MWR, FBC and other national partners
to evaluate potential of SHP sites

more effective decision making process, SHP design and development</td></tr>
<tr><td colspan="4">Indicators</td></tr>
<tr><td colspan="2">Number of staff trained and capable to carry on initial assessment of SHP sites
Number of SHP sites identified during a desk study</td><td colspan="2">Number of sites assessed in the field
Number of sites in the data base</td></tr>
</table>

7 COMPONENT 4: MINIMUM HYDROMETRIC NETWORK TARGETING SHP DEVELOPMENT

7.1 Component rationale

The overall objective of the component 4 is to promote the development of sustainable SHP renewable energy through reducing the deficit of quality hydrological data required for planning, feasibility assessment and design of prioritized SHP projects in Sierra Leone.

Hydrological data in Sierra Leone are scarce and unreliable. The hydrological network and hydrological data collection system in Sierra Leone are not working. Lack of actual hydrological data and limited historical records makes it difficult to give a comprehensive and updated summary on the SHP resources. The insufficient information is a serious handicap to the incoming hydropower studies. In the short term, the data scarcity will mean that the estimates of plants production capacity and determination of most economical plant size will be less accurate, than would normally be possible and desired. Absence of site specific hydrological data could be one of the major reasons for a suboptimal decision making and relatively superficial feasibility studies.

The Component 4 is to be seen as a logical continuation of the already completed activities under Component 3. The implementation of the Component 4 should start in January 2018 and the project will last over 24 months. The specific component's objectives are:

1. Establish and secure smooth operation of a minimum network of hydrometric stations and hydrological data collection system that would address hydrological data needs of SHP hydropower development

2. Assist in the strengthening of the MWR with appropriate capacity building that will enable it to carry out its mandate to operate and maintain the established hydrological data information system

7.2 Main outputs and outcomes

The expected major outputs from the Component 4 are:

- Operational minimum hydrometric network consisting of 4-6 hydrometric station located in the vicinity of the most promising potential SHP sites selected for future feasibility studies.
- A trained team of MWR employees capable by itself to install, maintain and operate hydrometric stations.
- A provisional hydrological database and the MWR staff trained to collect quality check and store field data in the data base.

The Component 4 should considerably reduce uncertainty and enhance quality of background hydrological information for project evaluation and feasibility studies. Since long-term measured flow data are not available in Sierra Leone, even short flow records collected prior to a feasibility study an covering two dry seasons and one monsoon season will be of value. These flow data could give an idea about minimum discharge and flow seasonality at the sites as well as improve data background for estimating plant capacity and facilitate plant design. The established data base will provide easily accessible information for all users fostering more effective hydropower and water sector development

The long-term outcome of Component 4 will be the enhanced institutional capacity of MWR and the increased professional skills of MWR staff to construct, maintain and operate hydrometric network. This should effectively help in the re-establishment of the national hydrometric network for collection of high quality hydrological data. The monitoring network in Sierra Leone can be reconstructed incrementally with an aim of scaling up to sustainable national network that will in

the future serve needs of various water resource users.

7.3 Mode of implementation

The Component 4 is a complete project on its own that partly builds on the foundation created by the Components 1 and 3.

Implementation of the hydrometric network component is planned for a period of 24 months, starting in January 2018. The MWR will be a primary stakeholder and a local lead partner for upgrading of the hydrometric network in Sierra Leone.

The project will be implemented by a commissioned Consultant in partnership with the local stakeholders. The Consultant will have an overall responsibility for delivery of expected outputs. The MWR will have a lead role in coordinating the activities in Sierra Leone.

For the entire duration of the project, the MWR will assign to the project a team of 6 employees. Respectively, the MoE will delegate 2 staff and FBC will be invited to provide 2 supporting professionals. Prior to the project start, the availability of the work resources (professionals) shall be confirmed at the highest management level of the partner institutions.

Before the project start, recurrent costs of network operation and maintenance as well as data collection system costs need to be calculated. It should be clearly understood that day-to-day operation of the network is quite expensive. Funds should be secured (committed by GoSL or donors) for minimum 3 years of the network operation after the project completion. In case of the lack of funding or insufficient funding for network operation the project should be postponed or narrowed to capacity building and training task.

Detailed Terms of Reference have to be developed prior to the project start. It is suggested that the Component 4 will be executed in two overlapping phases, with the Phase 2 commencing once the core of the hydrometric network has been implemented.

Phase 1 of the project should include:

- Identification, hydrological assessment and evaluation of station locations. Conclusion about the number of stations to be installed,
- Assessment skills requirements to be addressed in the training of this project,
- Specification equipment and consumables for construction of stations,
- Specification of equipment for instrumentation hydrometric station,
- Procurement and purchase of equipment and materials,
- Specification an procurement of streamflow gauging equipment,
- Specification and procurement safety equipment for personnel,
- Construction and instrumentation of hydrometric stations.

The theoretical and intensive on-the-job training during Phase 1 should cover following:

- Identification of suitable site for hydrometric stations,
- Surveying and levelling,
- Water level recording equipment,
- Construction of flow gauging stations,
- Discharge measurement equipment,
- Discharge measurements,
- Station’s observers training.

At the end of Phase 1, stakeholder workshop should be held to present the achievements and lessons learnt and to map the way forward in terms of prioritisation for data collection platform and training needs of the second Phase.

The following activities should be undertaken during Phase 2:

- Assessment of project personnel capacity with regard to computer skills and data handling
- Design and implementation of system for collection of data recorded at the hydrometric stations
- Specification of appropriate data base solution (simple Excel, Access or professional hydrological data base)
- Implementation of data base

The training during Phase 2 should cover following:

- Computer training
- Operation of the implemented data base software
- Hydrometric data storage and initial quality check

When designing the Component 4 the Consultant should consider following standpoints:

1. Hydrological data quality is not directly related to technology employed at stations but rather to the way the network is run and maintained.
2. For the planned network the most appropriate technologies suitable to local conditions and skills of the staff should be selected. It is crucial to remember about the high costs and necessary support from professionals for servicing and maintenance of technologically advanced automated instruments.
3. Training of personnel with varied/limited educational background requires personalized support and tailor-made training with a strong on-the-job training component.
4. To minimalize vandalism of installed field equipment it is necessary to involve local communities in providing security and protection for installations and to inform/educate communities about the benefits of collected data.
5. The provisional database could be a starting-point for hydrological data storage. Available commercial data base packages are quite complex. The cost of software, implementation and necessary training is very high. A volume of the collected data will be limited and for some years these data could be effectively stored in the temporary Excel/Access data base. This type of temporary solution is not perfect but it could be easily managed by the employed MWR staff giving time to build up their computer skills and data base operation capacity.

The expected outputs, outcomes and respective indicators for the Component 2 are summarized in the result matrix shown in the paragraph 7.4.

7.4 Result Matrix

<table>
<tr><td colspan="5">Component 4 – Establishment of minimum hydrometric network targeting SHP development</td></tr>
<tr><td>Lead Partner</td><td colspan="2">Ministry of Water Resources</td><td>Partners</td><td>MoE, FBC, ECREE,</td></tr>
<tr><td>Participants</td><td colspan="4">Team of 8 staff from MWR, MoE and FBC</td></tr>
<tr><td colspan="2">Input/Resources</td><td>Activity</td><td colspan="2">Output</td><td>Outcome</td></tr>
<tr><td colspan="2">Inputs to be provided by ECREEE:
• Administrative and technical support services
• Funding support of ECREEE
• External technical assistance – international expert
• Training aids, manuals
• Procurement of equipment

Inputs to be provided by partners
• Team staff – dedicated input time
• Office space
• Logistic support: transportation,</td><td>Identification of most important sites for stations construction
Construction of 4-6 hydrometric stations
Procurement of equipment
Installation of equipment
On the job training of observers
Establishment of temporary data collection and data storage system
At each stage - on-the-job training of the team (station construction, equipment installations and operation, discharge measurements, temporary data base)
Continuous operation of the network and data collection system</td><td colspan="2">Operational Sierra Leone’s minimum hydrometric network and hydrological data collection system targeting SHP development.
Team members trained and capable to install and operate hydrometric stations.
MWR staff trained and capable to collect and store hydrological data in provisional data base</td><td>MWR team
Enhanced water knowledge and base for sound water management decisions
Data base providing easily accessible information for all users fostering more effective hydropower and water sector development</td></tr>
<tr><td colspan="5">Indicators</td></tr>
<tr><td colspan="3">Number of hydrometric stations established
Number of staff trained and capable to install and operate hydrometric stations
Number of staff trained and capable to collect and store hydrological data in temporary data base</td><td colspan="2">Hydrological data timely quality checked, analysed and archived in the data base</td></tr>
</table>

8 ORGANISATION AND MANAGEMENT

8.1 Institutional setting

The four delivery components compose a rather complex program. There are, however, many interrelations and complementarities between these components and normal project management practice will suffice to manage them. It is recommended a rather flat and flexible management structure that can be adjusted depending on tenders that are received by ECREEE and subsequent contractual negotiations.

The ECOWAS Centre for Renewable Energy and Energy Efficiency will be the Coordinating and Executing Agency. ECREEE will ensure that the program takes maximum benefit from lessons learned in implementing previous renewable energy projects, and is implemented in accordance with the organization priorities for acceleration of renewable energy deployment, and facilitation of knowledge sharing and technology transfer to provide clean, sustainable energy for West African countries.

The project will be executed with human and material support from the executing agency in close cooperation and collaboration with local partners and technical assistance from the contracted consultants.

8.2 Project Steering Committee

A Project Steering Committee (PSC) will be established to monitor the project coherence with the priorities of GoSL, project strategy, and implementation plans. PSC will advise on any possible changes in the direction of the program and approve major alternations of activities. The PSC will meet once a year. The PSC will be composed of

- One representative from each key local partner (MoE, MWR, FBC, UNIDO),
- One representative from the executing agency (ECREEE),
- One representative from the Donor (dependent on number of donors),
- One representative from the technical Consultant working with particular program component.

The key functions and responsibilities of the Program Steering Committee will be:

- Approve the general policy and strategy of the program,
- Manage disputes and possible disagreements between technical consultants, local partners and institutions
- Approve the execution plans for individual program components,
- Supervise project implementation,
- Approve possible amendments in the components arising from the identified risks ,
- Evaluate the progress and results of project,

8.3 Coordinating and Executing Agency

The ECREEE will coordinate and facilitate the program implementation. The Executing Agency will be responsible for implementation, management, administrative and financial control of the project. The Executing Agency is experienced in managing multilateral cooperation projects and is a credible institution for donors and International Organisations.

The Executing Agency will collaborate with the commissioned technical consultants and local partners to set up a final flexible management structure that can be adapted to the needs of the individual program components. The key functions and responsibilities of the Executing Agency will be:

- Take a lead role in identification of donors and seeking project funding

- Take charge of the administrative management of project,
- Coordinate and manage the financial resources of the project,
- Prepare ToR and all tender documents for the acquisition of technical consultants
- Evaluate and award contracts for technical consultants
- Contract management with the technical consultants
- Contract management with the project partner institutions in Sierra Leone
- Monitor the project implementation schedule,
- Prepare all tender documents for the acquisition of equipment and award of contracts.
- Evaluate tenders for equipment
- Manage material and equipment purchase contracts,
- Manage contracts with service providers,
- Monitor and report on the progress of project to the PSC and donors.
- Conduct the financial monitoring of the project and report to the donors.

8.4 Local lead partners

The Ministry of Energy, the Ministry of Water Resources and FBC will be the key local partners leading the individual program components in Sierra Leone. They will have an important responsibility in the project implementation and are indispensable to ensure the success and sustainability of the program. The main functions and responsibilities of the Local partners will be:

- Provide required, appropriately qualified, staff to participate in the program components,
- Provide the ECREEE and technical consultants with information and data needed to attain the component's objectives,
- Provide the necessary support during missions by the technical consultants and providers of equipment and service,
- Assist in obtaining the necessary permits and provide documents to support the program staff for entering into and exiting from Sierra Leone and in-country locations, including arranging for any necessary permits,
- Facilitate all procedures to ensure easy implementation of the project (permit for installation of equipment on the ground, passage of materials across the borders, custom clearance of equipment, etc.),
- Provide assistance in organization of workshop and secure workshops venues,
- Provide assistance in production and input to progress and final reports,
- Carry out construction and other work required to establish the hydrometric network with the assistance of contractors where needed,
- Make available to national authorities, users and the general public, information resulting from the project.

8.5 Technical Assistance

Where ECREEE does not have capacity itself, it shall provide the required services under consultancy agreements. Procurement of such consultants will follow ECREEE procurement rules. ECREEE will prepare the ToR and will commission one technical consultant for the entire program or individual consultants for the respective program components.

The consultant will be responsible for the technical coordination and quality assurance of each of the program components in order to meet the component objectives and outputs. Technical consultants will be involved in all of the activities envisaged for the preparatory and implementation phases, as outlined in the project document and the detailed plan of action.

Detailed responsibilities of the technical consultants working with the separate components will depend on the ToR prepared by the Executing Agency ECREEE and subsequent contractual

negotiations. The key functions and responsibilities of technical consultants will be:

- During the inception phase, together with the Executing Agency, update/adjust the detailed work plans and schedules for project activities including monitoring and assessment indicators,
- Technical support of the partner institutions (lead, capacity),
- Resolving technical problems and ensure that remedial actions are taken,
- Supervision and coordination of the component specific project teams,
- Design and implementation of training programmes,
- Development of training aids, manuals and presentations,
- Active participation, quality assurance and technical guiding of mapping and assessment of potential SHP,
- Selection of hydrometric equipment appropriate for local conditions and skills level,
- Assist in preparing the technical specifications for the equipment and software to be purchased for the project and the related calls for tenders,
- Assist participating countries to establish sustainable and appropriate hydrometric network and hydrological information system,
- Assist with project implementation through the introduction and monitoring of standard operating procedures and capacity building,
- Prepare progress reports for consideration by the Steering Committee,

9 WORK PLAN AND BUDGET

The implementation of the PSHD Program is planned for a period of 3 years (starting October 2016). The showed in Table 3-1 timeline for the components implementation schedule is provisional. ECREEE together with the commissioned technical consultants will formulate a detailed work plan for each of the components, once the required funds for the execution of activities have been secured and received.

Table 9-1 The program indicative implementation schedule

Component	Start	End
1: Practical training in river flow measurements	October 2016	November 2016
2: Rising awareness on small hydropower potential	October 2016	February 2017
3: Inventory of potential small hydro power sites.	December 2016	November 2017(1)
4: Upgrading hydrometric network	January 2018(2)	December 2019

(1) Dependent on progress of field assessment possible extension to June 2018

(2) The actual start of the Component 4 will depended from the progress of Component 3

The detailed work plan with the phasing of various components and activities is given in Appendix 1.

The tentative total cost of the PSHD Program is estimated at some 730,000 Euro over three year's period. The overall budget for the proposed components is given in Table 9-2. This component's budgets include a contingency amount of 10%. An itemized resource estimate is provided in Appendix 2. Required resources are related to the individual components and activities as far as this has been possible. Costing of equipment has been based on the 2016 international prices.

Table 9-2 The overall budget for the proposed components

Component	Total Budget (EUR)
1: Practical training in river flow measurements	72,500
2: Rising awareness on small hydropower potential	50,000
3: Inventory of potential small hydro power sites.	325,000
4: Upgrading hydrometric network	353,000

ECREEE will be in charge to address donor organizations and contributions by the partner institutions in order reach the full funding of the 3 year program. The list of the actual donors is shown in Appendix 3.

10 MONITORING, REPORTING AND EVALUATION

Monitoring, information system, indicators

The Executing Agency ECREEE will be responsible for the continuous monitoring of the progress of the program and individual program components. The result matrix has been developed for each of the program components. Each matrix includes the indicators for achieving the component objectives. Experience from previous renewable energy and capacity building project shows that some indicators might be found to be not relevant, while other may be identified during implementation. Any major shift of indicators suggested by technical consultants will be approved by the Executing Agency.

A technical consultant assigned to individual program component in cooperation with a lead local partner will be responsible for reporting. Reports will follow the standard report format and content as used by ECREEE. The components will produce following reports:

- Component 1: final report
- Component 2: final report
- Component 3: inception report, quaternary progress reports and final report
- Component 4: inception report, quaternary progress reports and final report

The Executing Agency ECREEE will be responsible for reporting of budgetary application and budgetary status. The annual program progress reports will be elaborated by ECREEE and will be submitted to PSC 3 weeks before Annual Meetings for the program. .

An independent expert (or experts) will undertake an evaluation of the PSHD Program at the end of the project.

11 SUSTAINABILITY AND RISKS ELEMENTS

The following risks and challenges have been identified which are considered to be outside the control of the program management:

1. Return of Ebola epidemics - Force Majeure
2. Political risks

The sustainability of the various components under this program will be ensured through the mode of working. Counterparts in Sierra Leone will ensure that each activity and component is implemented in a jointly manner and adapted to the Sierra Leone context.

Generally, projects are more likely to be maintained if they clearly meet a need of which the government is (preferably, acutely) aware of. The Component 2, at early stage of the program, should considerably raise awareness about economic benefits of SHP inventory and regular collection of hydrological data.

The assumptions and risks which might threaten the sustainability of the intended outputs should be discussed among the institutional partners at very early stage of the specific component execution.

During the program execution, the effects of internal and external risks on the efficiency and sustainability of the program should be continuously monitored. Any major threat posed by the risk factors for successful implementation of the program should be straightaway reported to ECREEE so that possible mitigating measures can be adjusted and introduced to secure sustainability of the program results.

Strong commitment of local partners will be critical for the success of the components 1 and 2. It is therefore expected that local partners will drive the training and workshops implementation by, among other things, securing the training/workshops venues and facilitating the logistics.

The availability of the qualified local partner’s staff for the team’s formation and execution of work tasks will be critical for a success of the components 3 and 4. It is therefore expected that at the initial project stage the partner institutions will identify and assigns dedicated team members and that their availability we be confirmed at the highest managerial level of partner institutions. In case of problems with staffing and assembling of teams a postponement of the project should be considered. A risk assessment summary is presented in the Table 11-1.

Table 11-1 Risk and Mitigation Matrix for the proposed program components

Risk/Challenge	Mitigation Measure
Component 1: Practical Training in River Flow Measurements	
Trainees are lacking sufficient technical background	Training pre-screening interviews (ECREEE)
Lack of trainees involvement	Attractive aids, short concentrated sessions
Participants unprepared for field work	Information about gear and clothing
Logistics problems	Transportation/accommodation secured at advance
Shortage of equipment	Supporting equipment from LHS
Personnel leaving the government service after training	Training incorporated into FBC curriculum – new professionals trained
Component 2: Rising Awareness on Small Hydropower Potential in Sierra Leone	
Insufficient funds	ECREEE and Local partner institutions actively seek additional funds from donors
Weak participation from highest political and managerial level	Support from the Minister of Energy and the Office of President Very early information/invitations including workshop agenda Participation request letter Attractive workshop venue
Logistic and organization challenges	Hired dedicated workshop manager
Component 3: Inventory of Potential Small Hydro Power Sites	
Insufficient funding	Local partner institutions actively seek additional funds
The lack of capacity could be an issue in Sierra Leone and constitutes substantial risk that needs proper mitigation measures. This is all the more important in the case of this project since it will be operating with a newly created project team with no experience in field work	Due to the relative complexity of the project, an internationally experienced technical consultant in SHP assessment will be brought on board to handle and coordinate project implementation activities.
Any disruption of the Team in implementing the project would have a negative impact, e.g., change in key staff, etc. The severity of the impact would depend on the nature and length of the disruption	The availability of the work resources for the EP should be confirmed by the highest managerial level of partner institutions. Development incentives strategy and introduction of incentives system
Project team with limited experience in assessment of hydropower potential	Continuous on-the-job theoretical and practical skills enhancement - support from technical Consultant,
Delayed start of the project with respect to the 2017 dry season in Sierra Leone	Desk study and training carried in 2016/2017. If necessary field assessment of potential SHP sites divided between the 2017 and 2018 dry seasons
Difficult access to primary data for desk study	Available in Sierra Leone data i.e. maps, satellite images historical hydrological data, historical reports etc. should be collected prior to the desk study start
Incomplete equipment	Start of equipment procurement during the desk study stage
Transport/ vehicles	Securing dedicated project vehicles for field work long-term renting/purchase
Component 4: Upgrading Hydrometric Network	
The MWR institutional setup of for hydrological data collection not in place	Postponed start of project or responsibility for hydrometric network temporary delegated to MRE or DoE
Insufficient team capacity could be an issue.	Due to the relative complexity of the project, a technical Consultant experienced in hydrometric network establishment in West Africa will be brought

Risk/Challenge	Mitigation Measure
	on board to handle and coordinate project implementation activities.
Project team with limited experience in installation and operation of hydrometric stations and discharge measurements equipment	Continuous on-the-job theoretical and practical skills enhancement - support from Consultant, Participation in ECREEE's and other international training courses
Lack of funds for operation of the network	Funds secured in advance for minimum 5 years of operation
Erratic availability of staff/work team	Availability of staff confirmed by managers. Staffed hydrometric unit of min 6 persons established
Transport/ vehicles	Securing dedicated project vehicles for field work- purchase of 2 vehicles
Equipment and spare parts	Procurement of equipment and spare parts
Ageing and faulty equipment	Project support to equipment maintenance and renewal

12 CROSS-CUTTING ISSUES

12.1 Good Governance and Anti-Corruption

The PSHD Program will build on the routines and practices for financial management of ECREEE. The programme budget and accounts will be open for inspection for at any time by donors and funding partners.

The long period of insurgency in Sierra Leone and lack of accountability mechanisms provided an enabling environment for corruption. Recent significant measures to improve transparency and accountability mechanisms, while still not functioning effectively, are positive signs of development.

Good governance of the programme is very important. Clear roles and responsibilities of all involved institutions will be developed. Routines for use and reporting of programme funds will be established to avoid treat of corruption. ECREEE's procurement procedures will be used. This means that evaluation of all tenders and procurement of equipment will be carried out in Cape Verde. Purchase of local materials in Sierra Leone and contracting of local work force will be closely monitored by technical consultants and will follow ECREEE procedures.

12.2 Gender

Energy institutions throughout the world tend to be male-dominated, particularly in the professional posts. The same trend has been seen in Sierra Leone. The Sierra Leone energy sector is male dominated and the planed PSHD Program can meet difficulties to include women in the implementation of the program at all levels, ranging from management to training of trainers at the local level.

The PSHD Program will use all means to secure that both women and men will participate in the project activities and further that both sexes will benefit from the programme activities. Gender neutrality will be assured in selection processes.

12.3 Environment

Hydrometry, hydropower and environment are closely linked together. Reducing carbon based electric generation and increasing generation from domestic renewable hydro resources is the major objective of the program. Safeguarding of local environment is an essential part of hydro based power production and will be an important aspect to be addressed by all program components.

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APPENDIX 1 WORK SCHEDULE

Proposed provisional work schedule

	Component	2016					2017												2018												2019												Comments
		A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
1	**Component 1: Practical Training In River Flow Measurements**																																										
	Preparatory work																																										
	Training event				T																																					
2	**Component 2: Rising Awareness on Small Hydropower Potential in Sierra Leone**																																										
	Preparatory work																																										Timing for workshop events is tentative and can be adjusted
	Workshop event 1				W																																					
	Workshop event 2				W																																					
	Workshop event 3							W																																		
3	**Component 3 – Inventory of Potential Small Hydro Power Sites**																																										
	Desk study																																										Activities in 2018 are optional-need for additional field surveys
	Field survey																																										
	Compilation of SHP data base																R							R																			
	On the job training																																										
4	**Component 4 – Minimum Hydrometric Network Targeting SHP Development**																																										
	Identification of sites for hydrometric stations construction																																										Input from the inventory study (Component 3)
	Procurement of equipment																																										
	Construction and instrumentation of stations																																										Optional schedule
	Establishment of temporary data collection and data storage system																									R																		Finalizaton of Component 3 in June 2018 - start of Component 4 postponed to November 2018
	On the job training																																										
	Operation of the network																																										

T	Training course
	On the job training
W	Workshop
R	Final report/product
	Optional/additional work

APPENDIX 2 PROGRAM BUDGET

Proposed program budget in EURO

Item	Component 1	Component 2	Component 3	Component 4
International technical assistance including technical input of ECREE	20,000	20,000	123,000	78,000
Local technical assistance	4,000	2,000	36,000	26,000
International travels	8,000	4,000	11,000	11,000
Per diems (international and local staff)	23,000	6,000	41,000	36,000
Equipment, tools, materials	1,000	1,000	25,000	100,000
Program expenses (logistics, venues, transport, local contractors, observers)	7,000	8,000	40,000	49,000
ECREEE administration fee - 7%	4,000	3,000	19,000	21,000
Contingency 10%	7,000	4,000	30,000	32,000
Total (EUR)	**74,000**	**48,000**	**325,000**	**353,000**

APPENDIX 3 LIST OF STAKEHOLDERS MET

NAME	POSITION	INSTITUTION	EMAIL	PHONE
Hon. Henry Serry	Presidential Adviser on renewable energy, science and technology	State House, Office of President SL	henrypserry@yahoo.com	+23279872715
Hon. S.E.Osmond Hanciles	Deputy Minister II, Power and Energy	Ministry of Energy	osmarbel@yahoo.com	+23276660993
Ing. Benjamin Kamara	Director of Energy	Ministry of Energy	benshinoh@gmail.com	+23276369538
Komba Momoh	Deputy Permanent Secretary	Ministry of Energy	komsco@yahoo.com	+23277652125
Paul Charles Saffa	Deputy Director	Ministry of Energy	paulsaf2000@gmail.com	+23276695329
Dr Edmund D. Klvseni	Head of the Planning Unit	Ministry of Energy		
Robin Fola Mansaray	Head of Renewable Energy & Energy Efficiency Unit	Ministry of Energy	robinmans2014@gmail.com	
Dr. PatrickTarawalli	Technical Adviser	Ministry of Energy	ptarawalli@msn.com	+23276612184
Mustafa Sannoh	Program Officer	Ministry of Energy	mustaphasannoh1@gmail.com	
Dr. Ing. E.D. Wuseni	Technical Adviser/Coordinator	MOE, Bambuna II Hydroelectric Project	edmundwuseni@gmail.com	+23276815257
Mohamed Sahr E Juanah	Head of Water Resources, Water Directorate	Ministry of Water Resources	msejuanah@hotmail.com	+23279912171, +23288289707
Obafemi B.A. Davis	Head of Civil Engineeering	Fourah Bay College, University of Sierra Leone	boadavies@gmail.com	+23230210839
Dr. Kelleh Gbawuru-Mansaray	Head of Mechanical and Maintenance Engineering Department/National Energy Consultant UNIDO	Fourah Bay College, UNIDO	mansaraykg@gmail.com	
Dr. Ing. E.D. Wuseni	Senior visiting Lecturer	Njala University, Post Graduate School of Science, Faculty of renewable Energy	edmundwuseni@yahoo.com	+23277542564
John. M. Koroma	Coordinator for Energy and Environmental Programmes	Njala University, School of Technology, Department of Physics and Computer Sciences	johnkoroma2013@gmail.com	+23276425060
Jobo Samba		Ministry of Lands, Country Planning and Environment	jobosamba@yahoo.com	+23278215650
Abu Rakon Jalloh	Data analyst/data management	Department of Meteorology		
Mohamed Abu	Administration Officer	Department of Meteorology		+23276673680
Alex B. Kamara	Consultant Director	Cemmats Group LTD.	akamara@cemmstssl.com	+23276601973
L.J. Tani Pratt	Managing Director	Cemmats Group LTD.	tpratt@cemmatssl.com	+23276601336
Mohamed A.R. Camara	Director Renewable Energy Centre	Government Technical Institute	yeabumagbass@yahoo.com	+23276646920
Joseph Tejan Cole		Government Technical Institute	josephtejan200@yahoo.com	+232770890

APPENDIX 4 LIST OF RELEVANT DONORS

AFREA, Africa Renewable Energy Access Programme, www.esmap.org

African Development Bank (AfDB), www.afdb.org/en/

AUSAID, Australian Aid for International Development, http://www.ausaid.gov.au/

DFID, Department for International Development, UK, http://www.dfid.gov.uk

DGIS, Directoraat-generaal Internationale Samenwerking, The Netherlands, https://www.gpoba.org/dgis

EIB, European Investment Bank, http://www.eib.org/about/

EU, Sierra Leone, Delegation-sierra-leone@eeas.europa.eu

GPOBA, Global Partnership on output-based aid, www.gpoba.org

IDA, International Development Association, www.worldbank.org/ida/

IFC, International Finance Cooperation, www.ifc.gov

JICA, Japan International Cooperation Agency, www.jica.go.jp/english

KfW, Frankfurt, Kreditanstalt für Wiederaufbau, www.kfw.de

MCC Millennium Challenge Corporation, USA, www.mcc.gov

OeEB - Oesterreichische Entwicklungsbank AG (Development Bank of Austria), http://www.oe-eb.at/en

Norwegian Government, Embassy Accra, http://ghana.norway.info/

Power Africa, USA, www.usaid.gov

USAID, USA, www.usaid.gov

World Bank, USA, www.worldbank.gov