

DRAFT

National Mission on Small Hydro

Enriching Remote Areas through Small Hydro

1. Introduction

The National Mission on Small Hydro will be a joint initiative of the Government of India and State Governments to enrich remote and rural areas in power generation. The mission would give unique opportunity of entrepreneurship development, lively hood opportunities in rural areas and would be an effective tool to achieve 24X7 Power to all.

1.1 Hydropower represents use of water resources towards inflation free energy due to absence of fuel cost with mature technology characterized by highest prime moving efficiency and spectacular operational flexibility. Out of the total power generation installed capacity in India of 2,53,389 MW, hydro power contributes about 16.3% i.e. 40,798 MW. The total hydroelectric power potential in the country is assessed at about 1,50,000 MW. The share of hydro power in our country, in the total installed capacity of power generation, is continuously decreasing. It has come down from 46% in 1960 to 16.33% in 2014.

1.2 In India, hydro projects up to 25 MW station installed capacity are classified as Small Hydro. The potential of small hydro power (SHP) projects is estimated at about 20,000 MW. Small hydro projects are normally run-of-river and no dam is constructed. These projects do not encounter the issues associated with large scale hydro projects of deforestation, resettlement and rehabilitation. The projects have potential to meet power requirements of remote and isolated areas. These projects have the potential to turn around economic activities in local areas, villages and remote areas. These factors make small hydro as one of the most attractive and reliable renewable source of grid quality power generation. With the advancement of technology, it is now possible to set up economically viable low head small hydro projects on existing canals and fall structures, dam outlets and small streams spread through the country. New technologies of hydro kinetic turbines are opening avenues to setup small size power projects using flowing velocities of flowing water in rivers and canals.

1.3 The Government, in its manifesto has promised to set up small hydro power generation projects to harness the hydro power.

1.4 Considering the need of remote and rural areas and advantages, a National Mission on small hydro is proposed to be launched.

2. Importance and relevance of small hydro for India

2.1 Electrification is a significant step towards poverty alleviation, income generation, health, and other developmental objectives. Electrification has a major impact on rural society by bringing in higher productivity through electrical machinery, higher number of productive hours in the day through electric lighting and better access to affordable education, health, connectivity and entertainment. It enhances the quality of life. Small and mini hydro projects have a unique advantage that apart from green power, it delivers grid quality power and can be set up both in grid connected as well as off grid mode as per the need. Electrification of remote un-electrified villages through mini hydro/ micro hydro/ Watermills/ individual household units also have a definite positive impact on the rural economy due to introduction of a new revenue generating entity into the system and the jobs that are created due to its establishment and availability of electricity. Small hydro projects can enrich remote and rural areas and becomes a permanent source of power and income generation.

2.2 The small hydro sector has two distinct components. One, SHP projects in MW size capacity range, which are grid connected and normally developed by the State Government or by a private developer. These projects are instrumental in increasing installed capacity of power generation in the State and eventually overall capacity addition in the country. Apart from this benefit, where the project is being developed there is a series of socio-economic activity in the project area which helps in overall development. Since the power project is a permanent asset in remote area, it provides sustainable economic activity and employment opportunity. The other component of SHP programme is of decentralized power and energy generation through micro hydro and watermills. These applications have the potential of developing local entrepreneurs and meeting energy requirements of a village / community. A small / micro hydro project and watermills have the potential to provide sustainable economic growth to village community along with livelihood and agro/ cottage/ small industrial activities.

2.3 Situation Analysis

- (i) The estimated potential of power generation from small hydro projects is about 20,000 MW. While all States have possibility to set up small hydro projects, about 50% of small hydro identified potential lies in the States of Himachal Pradesh, Uttarakhand, Jammu & Kashmir and Arunachal Pradesh. In the plain region Maharashtra, Chhattisgarh, Karnataka and Kerala have sizeable potential. State-wise details of the potential are given at **Annexure-I**.

- (ii) In the year 2000, the total installed capacity of small hydro projects was 1275 MW. There has been an increase of about 150% in the installed capacity during 2000-2010. A continuous and steady growth was seen in the SHP sector. During the 9th Plan, a total capacity of 269 MW was added. This capacity addition had increased to 536 MW during the 10th Plan and 1419 MW during the 11th Plan. The average capacity addition of 55 MW per year during the 9th Plan had increased to 284 MW per year during the 11th Plan. However, this has declined to about 170 MW in the year 2013-14. So far, 1001 small hydropower projects aggregating to 3,832 MW have been set up in the country, of which 320 projects of 1662 MW are from private developers.
- (iii) Electricity and electricity generated from hydro projects are concurrent subject of Central and State Governments. 24 States have announced their policies for private sector to set up SHP projects. CERC issue guidelines for determining tariff of power generated from SHP projects and SERCs, in their respective States, have accordingly announced tariff and other conditions.
- (iv) The sharp increase in installed capacity of SHP projects during 10th and 11th Plan can be attributed to participation of private sector. The SHP programme in India is now by and large private investment driven. Generally, SHP projects are economically viable and private sector has been showing interest to set up SHP projects. The viability of these projects is normally directly proportional to capacity of the project. Most of the States with reasonably high SHP potential have been interested in allotting the projects to the private sector for implementation and operation. Since SHP projects had reasonably good economic viability, a number of financial institutions and banks were financing these projects.
- (v) However, this situation has changed in recent past. The Private sector is no more finding SHP sector attractive enough to make investments. The costs of projects have gone up and tariff given to the power generated from SHP projects is no more attractive and not supporting investments. Low rate of average pool power purchase rate in hydro rich states and non-sale of Renewable Energy Certificates in the open market are some of the other reasons for declining interest in the SHP sector. Some of the other reasons are long implementation time and multi departmental statutory clearances associated with the projects. The projects involve time consuming process for allotment of sites by the States and statutory clearances including land acquisition, forest clearance, irrigation, fisheries, district administration, local panchayat, clearance etc.
- (vi) The experience of past 15 years shows that a faster growth in the SHP sector is possible only with active participation of private sector. Seeing current trends in States, a major part of capacity addition and exploitation of SHP potential in future can only come from private sector projects. It is strongly felt that there is a need to systematically address issues responsible for slowdown of SHP sector.

- (vii) **Cost:** The Cost of constructing small hydro projects are continuously increasing and the tariffs offered by the States are not sufficient to justify fresh investments in the sector. The present cost per megawatt of small hydro projects is now touching about Rs. 8.50 crore to Rs. 9..50 crore per megawatt (MW). A number of small hydro developers were dependent on sale of Renewable Energy Certificates (RECs) generated from SHP projects in to the open market. However, non-compliance of RPOs by the distributing companies has truncated the REC market.
- (viii) **Environmental impact:** Small hydro being mostly run of river types is environmentally friendly as it has zero emissions while generating electricity. There is no storage of water and no dam is constructed in these projects and hence there are no displacements of habitation. The projects can address power requirement of local areas and avoid long transmission losses. Small hydro projects can also be helpful in mobilizing resources and save life in case of emergency in remote areas.
- (ix) **Energy Security of source:** From an energy security perspective, Hydro is the most secure of all sources, since it is dependent on locally available resource and quite predictable water cycle. It can be an excellent source of power generation to meet peak demands if small storage of one or two days is introduced. In the situation of energy shortages and non-availability of power in remote areas, small hydro can provide long term effective solution.

3. Objectives and Targets

3.1 The objective of the National Mission on Small Hydro is to address issues responsible for decline of SHP sector in the country and to regenerate interest of private sector to make investment in this renewable energy sector. Technological innovation, new methods of civil construction, standard designs and automation can be helpful in arresting the increase in cost of projects. The Mission would target to achieve 500 MW of capacity in next two years and aim towards adding 4500 MW in the subsequent three years, for which preparation including appropriate policy interventions will be done in the first two years of the mission. There are a number of canal drops in the country and can open new avenues for developing small hydro projects. The Mission would aim at technology development and set up 1000 MW SHP projects on canal drops, dam outlets and water outfall structures. The Mission would also help the State Governments to renovate old SHP projects and improve their capacity and efficiency. Identifying new potential sites would be taken up. The Mission would develop a programme of micro hydro and water mill for hilly regions of the country to provide off-grid power supply linked to economic activities in remote and rural areas. The feasibility of local grid would also to be worked out.

3.2 To achieve this, the Mission targets are:

- I. To create an enabling policy framework along with the state governments for the deployment of 5,000 MW of small hydro projects by 2019 and a platform for long term sustainable growth in small hydro sector.
- II. Encourage and enable all the States to participate in the National Mission of Small Hydro for setting up new SHP projects, provide conducive policy and institutional support for SHP projects by private sector.
- III. Evaluation of all existing Government sector small hydro projects with a view to Renovate, Modernize and uprate (RMU) them, if required, to improve efficiency and add capacity where ever possible.
- IV. Develop new technologies and engineering solutions to set up low and ultra low head (below 3m) small hydro projects on canals, dam outlets and water outfall structures. Projects of 1000 MW on canals and existing water structures by 2019.
- V. Develop a network of water mills, individual household systems and micro hydro projects in remote and rural areas and set up 5000 water mills/micro hydro projects and establishing local mini grids.
- VI. Undertake systematic study to identify new small hydro potential sites

4. Mission strategy and proposed activities

4.1 The National Mission on Small Hydro is proposed to be launched from 1st April, 2015.

4.2 The first phase would be for two years where policy issues concerning slow pace of small hydro sector will be addressed. A capacity addition of 500 MW will be targeted, State sector old small hydro projects would be reviewed and assessed and DPR prepared for their RMU. The technology development work would be started for low and ultra low head canal based small hydro projects. Network to take up water mills / individual systems and micro hydro projects in remote and rural areas through entrepreneurs will be established and action to identify new potential sites in the country would be initiated.

4.3 With the National Mission in place, setting up of small hydro projects would be declared as "Priority"

4.4 The Phase-I would put in place policy frame work to achieve the objectives of the National Mission on Small Hydro by 2019. The policy announcement will create the necessary environment to attract project developers to invest in development of small hydro. The Mission will work closely with State Governments, Regulators, Power utilities and Local bodies to ensure that the activities and policy framework being laid out can be implemented effectively. Since most of the State Governments have some policy already announced, the Mission would draw up a suitable transition framework to enable revive the sector.

A. Grid connected small hydro projects by Private Sector:

4.5 Water being State subject, the SHP projects is governed by the State policies and the potential sites are allotted by the State Governments to private developers. The projects involve time consuming process for allotment of sites by the States and statutory clearances including land acquisition, forest clearance, irrigation clearance etc. The small hydro projects have relatively longer gestation period in completing due to difficult terrain and limited working season. In addition, the location of the projects is remote and evacuation facilities for power generated from projects are very weak.

- The Mission is recognizing that a large part of targeted capacity of SHP projects would have to come through private investment. State Policies would be reviewed to ensure that the momentum of private sector participation in SHP is regained.
- The key driver for the mission would be “Reasonable and assured rate of return on investment” of private sector. The present cost per megawatt of small hydro projects is now touching about Rs. 8.50 crore to Rs. 9.50 crore per MW. The feed-in-tariff offered by the CERC and SERCs needs to be reviewed periodically.
- Another instrument for promoting small hydro would be through Renewable Purchase Obligation (RPO) mandated for power utilities. The Renewable Energy Certificate (REC) trading would be promoted with reasonable average pooled purchase cost. The Ministry of New and Renewable Energy would closely work with CERC and Ministry of Power to address these issues.
- In last 3-4 years, most of the projects have come up in HP, Punjab, Karnataka, and Maharashtra. There is a need to encourage more States and bring them on board for developing more Government / Private sector projects. While all the States would be motivated to participate in the National Mission, focus would be to be given to J&K and Uttarakhand in North, Tamil Nadu and Kerala in South, M.P and Chhattisgarh in Central and Sikkim, Meghalaya and Mizoram in North East of India.

- State wise, year wise targets are proposed to be fixed in the Mission with identification of projects likely to be commissioned in following 3-4 years. This would be done in consultation with States and project developers.
- Project wise monitoring would be undertaken at State as well as MNRE level.
- The Mission would start on- line status monitoring system for all projects

B. Development of small Hydro in the State / Public Sector

4.6 There are large number of potential SHP sites, which are in very difficult locations and will not be economically viable to be developed from commercial angle. However, such locations have the potential to meet power requirements of small villages in remote areas and extend the benefit of electricity in relatively short time. Private sector may not find it profitable to set up projects in many such locations and more specifically in border areas and in the NE States. These projects will need to be developed through State Government Agencies with support from the Central Government.

4.7 The scheme would focus on identification of more SHP projects in North-Eastern States and support the same to achieve proportionate installation of projects in consonance with the potential of small hydro in the NE States.

4.8 The Mission would come out with a strategy and financial package to support and develop such projects in a time bound manner either by public sector or in public private partnership mode.

C. Renovation and Modernization

4.9 Renovation and Modernization (R&M) of old SHP projects is considered as the most attractive way of increasing generation in short time and with low investments. There are over hundred SHP projects owned and operated by State utilities which if renovated could result in 30-35% more generation with relatively less investments. It is proposed to cover all these projects in a phased manner and provide partial financial support to the State utilities to undertake the R&M work of old projects. Models of partnership with private sector to renovate and run these projects would be encouraged.

4.10 The Mission would commission country wide study to collect information about all old state sector projects along with generation details, status of health of project and make project wise techno-economic feasibility report to take a decision about R&M of the project.

D. Identification of Future Potential Sites

4.11 A need to reassessing SHP potential in the country by using modern techniques like remote sensing and GIS has been recognized. This is an important step for systematically harnessing SHP potential in future. To accomplish this task the Mission proposes to earmark adequate funds for this activity. Being an elaborate work, some specific areas and States would be selected for pilot work would be extended to the entire country in a phased manner. This task would employ satellite information, GIS techniques and modelling. Possibilities of undertaking environment impact assessment along with potential assessment would be explored. Hydrological information would also be collected and compiled from on-going SHP projects for validation of modelling of potential. An user friendly data uploading and downloading facility by different interested groups shall be developed. The Central Government jointly with States Government would undertake this work. Role of State power department would be critical in success of this exercise.

E. Micro Hydro, Water Mills and individual projects

4.12 There is significant potential for development and up-gradation of watermills and micro hydro projects (up to 100 kW) in the country. Water mills and micro hydro projects can result in micro entrepreneurship development and meet energy requirements in remote hilly areas. It is proposed that the spread of micro hydro, water mill and individual projects would be enlarged. The micro hydro / water mill activity would also be linked to economic activities. The Mission would establish a network to encourage such projects through individuals and entrepreneurs. Private sector SHP developers would also be asked to set up micro hydro projects exclusively to meet power requirements of villages as social responsibility around their small hydro projects.

F. Manufacturing capabilities

4.13 The current manufacturing capacity for small hydro equipment is of about 1500 MW per year with in all the manufacturers. About 70% of the capacity is used for export. All major equipment manufacturers of Europe are represented in India. Small hydro is technically matured sector with an experience of about 120 years. The equipment used in small hydro projects is normally over 80% efficient. Advancements in the sector are of the nature of technical up-gradation. Permanent magnet generator is one of the recent innovations to take care variability of discharge in the stream thus avoiding expensive governors. The control systems in SHP projects have seen a good advancement in the last 10 – 15 years with inexpensive SCADA and automatic meter reading facility. The electric / electronic controls are now small and more reliable with user friendly automation. These are being achieved by the manufacturers through a mix of indigenous efforts and to some extent through technical collaborations. As part of the Mission, Indian manufacturers of

small hydro equipment would be encouraged to undertake development of low head turbine, velocity turbine etc. to open new avenues in the small hydro sector. If required, they would be supported for technology development and to set up some demonstration projects in different geographical areas.

G. Research and Development

4.14 The Ministry is supporting R&D activity in this sector mainly to create testing and standardization facilities. A set of 27 standards / manuals/ guidelines have been developed by AHEC, IIT Roorkee on various aspects / components of SHP projects. These would lead to more reliable and cost effective SHP projects. On-site testing facilities have been created to facilitate performance testing of SHP stations. A real-time digital simulator has been set up at AHEC-IIT Roorkee to provide training to SHP operators. Now, a hydraulic turbine R&D laboratory of International level is being set up which would act as an independent test laboratory for various turbine models and would also help in testing new designs of hydraulic turbines.

4.15 The Mission would strengthen R&D efforts and support development of velocity turbine and ultra low head turbines for canal / river based micro hydro projects. This apart, studies like cumulative impact assessment; measures to enhance life of small hydro projects, development of mini grid using small hydropower development along with small scale pump storage and other source of energy would be started.

H. Capacity Building

Hydropower involves multi-disciplinary human resources for planning, design, execution, management and operation & maintenance. Civil, electrical, mechanical, electronic engineering and socio-economy are the disciplines in which hydropower personnel needed to be trained. Due to rather difficult conditions in the areas where hydropower source exist the volunteers to take up hydropower as their field of expertise, are not easily available. Education and training local people only specially at Energy Diploma & Technician level. The multi disciplinary specialist course(s) at different level to match the requirement is required. A large number of training programmes, new courses, awareness programmes are to be offered by different institutions.

The Mission would address this requirement by involving various engineering institutions. Engineering colleges and ITI in hydro rich states would be supported to provide courses and training in small hydro domain.

I. Institutional Support Mechanism.

The gestation period of setting up a green field small hydro project is 3-4 years. Any effort done today, to accelerate capacity addition from SHP project would give results only after 3 years or so. One of the objectives of the Mission would be to set up institutional mechanism in each state, which can facilitate project developers to reduce implementation time and get technical and statutory support. The Mission would come out with guidelines in consultation with the States for systematically developing SHP potential including parameters for deciding capacity of the project, minimum water requirement in the stream, local area development strategy etc.

- i. The Mission would start activity for collecting hydrological information with the involvement of State Government so that future projects can be developed in minimum possible time.
- ii. The procedure for obtaining clearances required for SHP projects would be made online and MNRE should support the States to get this implemented.
- iii. The Mission would assist in organizing State level and district level orientation programme to sensitize local authorities for the benefits of timely implementation of projects.

5. Financing the Mission activities

The total budget for the Small Hydro Programme for 12th Plan Period is Rs. 825 crore. During 2012-13, 2013-14 and 2014-15 the budget for the programme was Rs. 159 crore, Rs. 137.50 crore and Rs 142.00 crore respectively. The Cabinet had approved incentive scheme for various components of the SHP programme for the 12th Plan period. The balance budget for the year 2015-16 and 2016-17 is Rs. 386.50 crore.

The National Mission of Small Hydro is essentially to address difficulties being faced by the private developers. These require some policy changes and some fiscal facilitations more than direct financial benefits. However, some activities of the Phase I of the Mission would require financial investments. It is assessed that the financial requirements of Phase I of the Mission, which is more of a preparatory to the Phase II, can be met within the 12th Plan allocations for the small hydro programme.

The funds required for Phase II will be worked out in the second year of phase I and would be part of the 13th Plan budget for small hydro programme. It may be mentioned that no direct subsidy to private sector projects is envisaged in Phase II of the Mission. But support to public sector projects, RMU of old projects, survey and R&D etc. would be required.

STATE WISE NUMBERS AND AGGREGATE CAPACITY OF SHP PROJECTS (UPTO 25 MW)							
POTENTIAL, INSTALLED & UNDER IMPLEMENTATION							
(as on 31.10.2014)							
Sl. No.	State	Potential		Projects Installed		Projects under Implementation	
		Nos.	Total Capacity (MW)	Nos.	Capacity (MW)	Nos.	Capacity (MW)
1	Andhra Pradesh	387	978.40	69	223.030	12	30.04
2	Arunachal Pradesh	677	1341.38	149	103.905	44	22.23
3	Assam	119	238.69	7	37.110	2	9.00
4	Bihar	93	223.05	29	70.700	5	17.70
5	Chattisgarh	200	1107.15	9	52.000	4	115.25
6	Goa	6	6.50	1	0.050	-	-
7	Gujarat	292	201.97	5	15.600	-	-
8	Haryana	33	110.05	7	70.100	2	3.35
9	Himachal Pradesh	531	2397.91	158	638.905	33	76.20
10	J&K	245	1430.67	37	147.530	7	17.65
11	Jharkhand	103	208.95	6	4.050	8	34.85
12	Karnataka	834	4141.12	147	1026.658	24	178.09
13	Kerala	245	704.10	25	158.420	11	52.75
14	Madhya Pradesh	299	820.44	11	86.160	3	4.90
15	Maharashtra	274	794.33	58	327.425	9	43.70
16	Manipur	114	109.13	8	5.450	3	2.75
17	Meghalaya	97	230.05	4	31.030	3	1.70
18	Mizoram	72	168.90	18	36.470	1	0.50
19	Nagaland	99	196.98	11	29.670	3	3.20
20	Orissa	222	295.47	10	64.625	4	3.60
21	Punjab	259	441.38	47	156.200	11	19.45
22	Rajasthan	66	57.17	10	23.850	-	-
23	Sikkim	88	266.64	17	52.110	1	0.20
24	Tamil Nadu	197	659.51	21	123.050	-	-
25	Tripura	13	46.86	3	16.010	-	-
26	Uttar Pradesh	251	460.75	9	25.100	-	-
27	Uttarakhand	448	1707.87	99	174.820	46	174.04
28	West Bengal	203	396.11	23	98.400	17	84.25
29	A&N Islands	7	7.91	1	5.250	-	-
Total		6474	19749.44	1006	3938.678	253	895.40