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Pressurised Water Supply in the Canal Commands for Micro Irrigation Using Solar/Grid Powered Infrastructure

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ABSTRACT: *The water use efficiency in irrigation sector will be achieved by adopting integrated approach in water management by increasing the available supply with reduction in conveyance losses and by increasing the field application efficiency with use of water in Drip & Sprinkler Irrigation technology. This purpose will be served by Installation of Solar/Grid Powered Micro Irrigation Infrastructure in the Canal Commands by providing common infrastructure with components Community based water storage tank near outlet head, Pumping Unit (Grid/Solar Powered), Filtration units, HDPE pipe network/Hydrant/Outlet assembly, Valves etc with Drip/Sprinkler irrigation sets will serve this purpose. The Solar Power System is proposed to be connected with the utility power grid so that the energy generated by the solar modules, whenever not required for operation of the pumping system or is in excess of requirement, can be sent to the Utility Grid through bidirectional meter.*

KEYWORDS: *Solar/Grid, Micro Irrigation, Canal Command, Irrigation Efficiency*

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I. Introduction

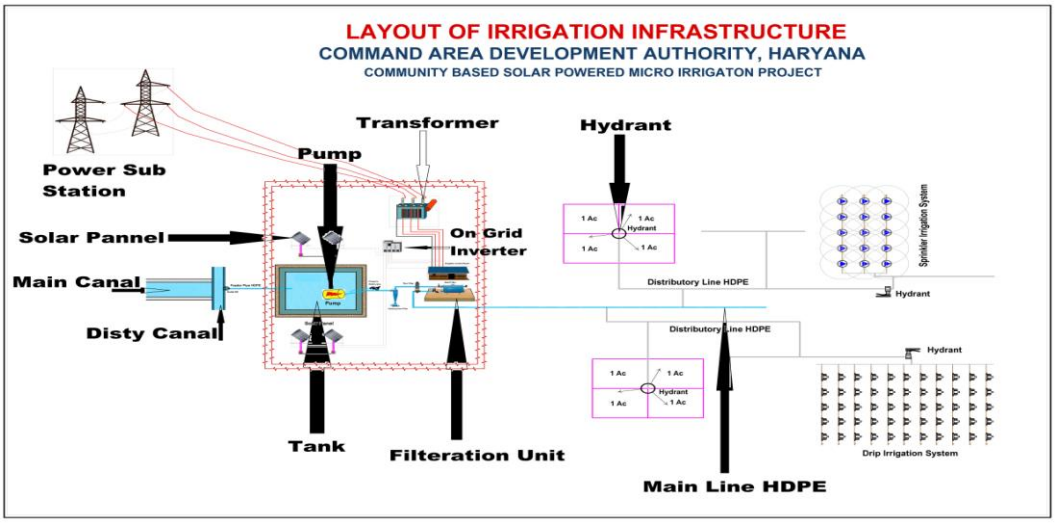
Haryana State, with geographical area of 4.4 Million Hectares, is mostly arid or semi arid with limited rain fall ranging from 300mm in the south-west to 1100mm in the north-east. There are no perennial rivers running through the state and about 2/3rd of the area is underlain with brackish water facing problems of rising water table and inadequate natural drainage. 80% of the cultivable area of the State stands covered by the various canal commands including the lift canal commands, but the actual average annual intensity of canal irrigation in the State is only about 70% (combined for both the crops of Rabi & Kharif) which clearly reflects the limited availability of canal water. Large dependence of the State's agricultural sector on the ground water has led to overexploitation of this source of water and consequently the water table has registered a steep fall in the fresh water belts and rise in saline ground water areas leading to the problems of water logging and soil salinity. Growing water crisis and need to produce more food per drop of water, requires adoption of water efficient irrigation methods instead of the conventional flood irrigation to increase the field application water use efficiency and to enhance crop productivity. Micro Irrigation systems have matured to their significance not only in water saving but also in efficient energy, labour and fertilizer management system for more crop production. Micro Irrigation Systems will be helpful in Uniformity of water application, Higher water use efficiency, No land acquisition and levelling, Assured Irrigation to the agricultural fields, Improving cropping Intensity, Increasing efficiency through judicious use of irrigation water, Saving farm land, appreciating land use and Improving socio economic condition of the farmers.

II. Methodology

Solar/Grid Powered Micro Irrigation Infrastructure in the Canal Commands has been installed by providing Community based water storage tank near outlet head, Pumping Unit (Grid/Solar Powered), Filtration units, HDPE pipe network/Hydrant/Outlet assembly, Valves etc. in the command area of canal outlet, as shown in layout plan Figure-1. Drip/Sprinkler irrigation sets will be installed by the individual farmers in their farm holdings by availing the benefits of subsidy. It is proposed to take water from canal outlet through underground pipeline with gravity and to store the same in the tank of appropriate size for construction of which the land shall be made available by the WUA of the shareholders of the canal outlet. Solar/Grid powered pumping system connected through net metering has been installed nearby the tank with proper filtration systems to avoid any chocking. Water has been carried to entire area of the chak of the outlet through HDPE pipe line network under pressure. The entire pipe network has been buried under ground at 3 feet deep to avoid land acquisition. Water with the requisite pressure for running of the drip/sprinkler set has been made available to each

shareholder at his farm holding through the common infrastructure to be operated & maintained by the Water User's Associations.

Figure -1 (layout Plan)



III. Design Parameters

Modified penman method has been used to find out crop water requirement and computed the peak water requirement in rabi & kharif season. In this scheme average water requirement of 2mm/day has been considered. Design of this scheme is based on actual culturable command area (CCA), approved discharge normally 2.4 cusecs/000 acres and schedule of running of canal outlet by collecting the authenticated data from the Canal Authorities. Each component of this scheme shall be designed in such a manner that minimum operating pressure of 2.5Kg/cm^2 available to the farmers on their farm gate. Size of the storage tank has been designed by considering discharge of the outlet and volume of water accumulated in 24 hours. A feeder pipe of required size in appropriate length has been provided from canal outlet to the storage tank by gravitational flow. Solar pumping system is a vital part of this scheme and in this scheme grid connected solar powered pump has been considered to reduce the cost of electricity of appropriate size. At least one pump is provided in a block of area 40 to 50 Hectare. Solar pumps of the capacity up to 10 to 20HP is preferred with average working of 14 hours/day. The HP of pump set required is based upon design discharge and total operating head. The total operating head is sum of total static head, friction loses worked out with hazen-williams equation in pipeline network and losses in filtration unit. Pipes in main line and sub-main shall not be below 110 mm (OD) and the size shall be decided based on the criteria to limit the friction loss in the main & sub main keeping the minimum flow velocity in the pipeline as 0.6m/sec.

HP of pump set = $\frac{QxH}{75e}$.

Q = discharge (in LPS)
H = head (in meter)
e = Pumping efficiency

Solar PV array of at least 1100wp capacities has been installed per HP rating of pumping sets and total capacity of the Solar pv array for operation of solar pumping sets has been worked out in such a manner that total annual solar energy generation from the PV power system in no case be lesser than the total energy requirement to run the Micro Irrigation System and there is no net import of energy from the utility grid on annual basis. For working out the total annual energy requirement of the Micro Irrigation System likely days of running of canal outlet in a year has been considered based on the actual schedule of canal running, but total running days of the canal in year shall not be any case be less than 180.

The output power of SPV would be fed to the inverters for conversion of the DC produced by SPV array to AC for operation of the motor pump sets and feeding the same into the nearest electricity grid through 11KV, 24 hours energised HT independent line after synchronisation when in excess of requirement. A hydrant

assembly has been provided with minimum 110 size for the land holding of every share holder with provision of at least one hydrant for every 04 acres or less.

IV. Conclusion

Significant irrigation from tube wells are being done in various districts of Haryana. Canal water use efficiency is very poor and ground water wastage in shape of flood irrigation is being over exploited. It also causes wastage of electricity. Use of micro irrigation infrastructure will reduce the use of tube wells by which ground water will be saved. In areas where ground water is saline causes less yield and soil degradation, conjunctive use of ground water with canal water will improve the soil quality and saved the electricity. More area can be brought under canal command, which was otherwise either rain fed or irrigated by tube wells. In the areas where canal irrigation is less and farmers largely depend upon rain water & ground water, which is very low & saline with no scope of ground water development, the only solution is creating of Micro Irrigation infrastructure on canal outlets. Where the ground water table is very high with brackish water, there are chances of creating the situation of water logging, which is harmful for soil properties. In these areas, it is essentially required to minimize the flood irrigation by replacing with micro irrigation. Hence, by installation of Solar/Grid Powered Micro Irrigation Infrastructure in the Canal Commands through integrated approach of supply management and demand management, yield & net sown area will increase, dependency of tube well & overexploitation of ground water will decrease, saving of highly subsidised electricity and above all change of the mindset of the farmers towards the use of available water judiciously.

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