

# In-Pipe Water Power Generation From Spherical Turbine

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## ABSTRACT

An environmental protective electrical power generating system is the need of this generation. This project relates to an innovative approach for generating electrical power utilizing the flow of sewer waste liquid, as the energy source for operating turbines which in turn, drive electrical power generators. The objective is to create self-sustainable system to generate electricity with the help of the kinetic and pressure energy of the flow of water which runs the turbine assemblies including spherical turbines coupled to generator, sequentially located in the subsequent channel of water. In this project activity, we will be studying the required process parameters, design requirements, operational parameters, cost of implementation and power generating capacity of a spherical turbine in-pipe water power generator for ten households in a street.

**Keywords:** Energy Extraction, Low Scale Power Generation, Clean Energy, Spherical Turbine.

## ARTICLE INFO

### Article History

Received: 1<sup>st</sup> June 2019

Received in revised form :

1<sup>st</sup> June 2019

Accepted: 4<sup>th</sup> June 2019

**Published online :**

**5<sup>th</sup> June 2019**

## I. INTRODUCTION

Conduit hydropower offers important new ways to enhance renewable energy portfolios in the United States, as well as to increase the energy efficiency of water delivery systems. Conduit hydropower projects are constructed on existing water-conveyance structures, such as irrigation canals or pressurized pipelines that deliver water to municipalities, industry, or agricultural water users. Although water conveyance infrastructures are usually designed for non-power purposes, new renewable energy can often be harvested from them without affecting their original purpose and without the need to construct new dams or diversions. Conduit hydropower differs from more conventional hydropower development in that it is generally not located on natural rivers or waterways and therefore does not involve the types of environmental impacts that are associated with hydropower. The addition of hydropower to existing water conduits can provide valuable new revenue sources from clean, renewable energy. The new energy can be used within the existing water distribution systems to offset other energy demands, or it can be sold into regional transmission systems. The selection of hydropower equipment for conduit projects can be relatively complex and challenging due to the combinations of heads and flows typically available in the water distribution systems, as well as the physical spaces into which they must fit.

By definition, most of the infrastructure for an in-conduit installation already exists. The main purpose of the infrastructure must be maintained throughout the development of the hydropower project (i.e., irrigation, agriculture, municipal use, etc.)

A primary design objective, therefore, is to minimize the impact of the hydropower facility on the existing infrastructure and environment, while maximizing total generation. Selecting appropriate equipment for a site is a critical factor in meeting this intent. Often there are also other requirements for hydraulic equipment such as bypass gates and valves and other devices to prevent the interruption of flow or other adverse impacts to the primary water system. There are many existing hydropower turbine designs that can be used in canals and pipelines. These hydraulic turbines are often of custom design and unless offered by a manufacturer in some type of standard package, can be expensive, especially in small sizes.

### 1.1. PROBLEM STATEMENT

Water agencies today face increasing financial challenges. The high cost of energy, coupled with energy efficiency mandates and the need to repair or replace aging

infrastructure all require creative solutions to keep operation sustainable.

Pipeline repairs and installations provide opportunities to deploy In-pipe water power generation from spherical turbine on wide scale, producing megawatts of renewable energy nationwide.

## 1.2 OBJECTIVES

- Generate clean, reliable, low cost electricity
- Eliminate dependency over fossil fuel.
- Energy security and to generate consistent, predictable energy 24/7
- To produce cheap and low cost electricity.
- To develop a water to wire system this is 2-3 times more efficient than solar and wind systems.
- To harness the energy by utilizing the flow velocity of water due to gravity from the dams.
- To reduce the use of fossil fuels for power generation and reduce pollution.

## II. PART IMPLEMENTATION

### 2.1. Construction

The spherical turbine Power System is a water-to-wire system that generates clean, renewable energy from excess head pressure in gravity-fed water pipelines. Spherical turbine converts water pressure to energy using a unique, lift based, vertical axis turbine installed within a pipeline. A single unit can produce 20 – 100kW of renewable, zero-emissions electricity, depending on the flow and head pressure conditions at a given site. Multiple units can be aggregated for a system that can produce more than a MW. The Spherical Turbine rotates the same direction regardless of the direction of the water flow and can accommodate flows in any direction through a pipeline. This means gravity fed water can pass through the system to generate power, while when the pipeline is used to convey pumped water in the opposite direction, the system can be stopped and the impact is virtually unnoticed. Typically, Spherical Turbine systems are designed to generate 240 volts, 3- phase AC power. Other configurations are possible.

#### 2.1.1.Spherical Turbine

A spherical turbine for any fluid type at any depth or elevation, which is capable of unidirectional rotation under reversible flow conditions, is disclosed. A spherical turbine is advantageous because, by design, it always remains symmetrical to flow, which is particularly useful in urban areas with tall buildings and in planar regions where winds are unstable, e.g. Patagonia. Moreover, in the field of mechanical engineering, a spherical frame is potentially the strongest and most reliable three-dimensional frame.

The turbine includes a rotatable shaft that is adapted to rotate about an axis of rotation and turbine blade support members that are fixedly attached to the rotatable shaft and to a plurality of meridian turbine blades. Geographically, a meridian is an imaginary arc on the Earth's surface that extends from the North Pole to the South Pole. In this invention, a meridian blade is an arced section

lying on the surface of a non-solid sphere, extending from a “north” point to a diametrically-opposite “south” point.

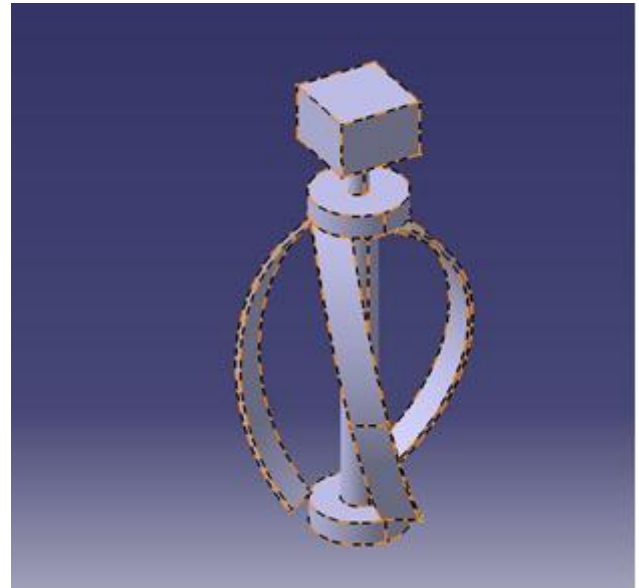


Fig. Spherical Turbine

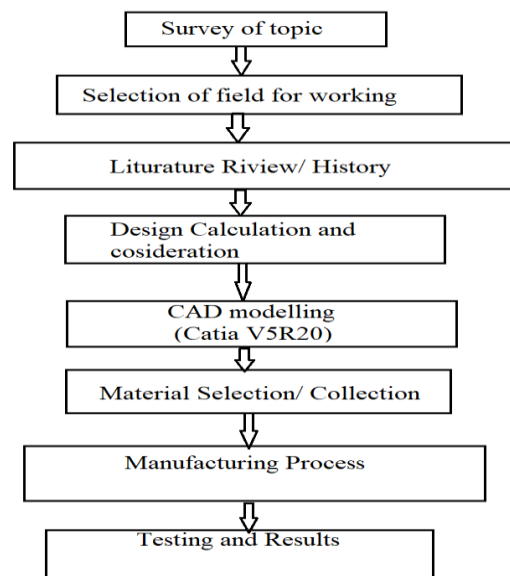
#### 2.1.2.Flow Velocity

Water velocity is the most important indicator for determining the energy generating capacity of a pipeline. The power generated by the Pipe is proportional to the cube of the water velocity. Water velocity helps determine the optimal size of the Pipe system that can be operated in a pipeline. Also factored in are the pipeline diameter, head pressure that is available for extraction and the capacity factor (frequency and duration of water flow).

#### 2.1.3.Flow with Full Head

Water flowing with full pie is the basic requirement for the rotation of the spherical turbine and gaining the maximum rotation possible. Ultimately it helps in extracting more energy.

## III. METHODOLOGY



Methodology Flow Chart

#### IV. WORKING

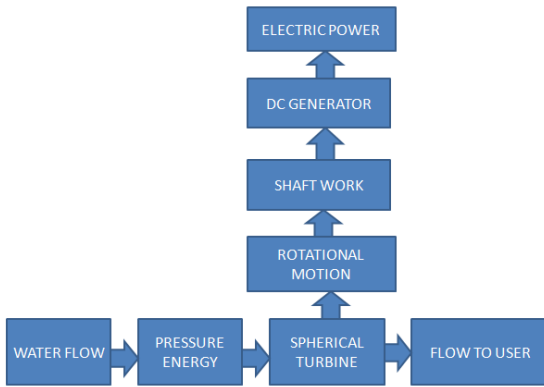


Fig. Basic Flow Chart

Water possess a lot of energy which is in the form of kinetic and pressure energy flowing vertically through pipe. The turbines working till date occupies a large amount of cross sectional area in pipe. When the area reduces, it converts pressure energy into kinetic energy which results in increase of velocity. This velocity of water is utilized in in-pipe turbine and used for generating electricity. The in-pipe water generator is an electrical power generating pipeline which can produce renewable energy completely clean, reliable low cost electricity. The in-pipe turbine is setup in the pipe, the flowing water strikes the spherical blades of the turbine and leads to the rotation of it. The vertical shaft of the turbine is coupled to the generator which generates electricity and stores in batteries.

#### V. ADVANTAGES, LIMITATIONS AND APPLICATIONS

##### 5.1 Advantages

- The modular pipe system to be placed on series, while allowing for uninterrupted water flow.
- Pipe does not need to be placed in a pressure transient zone or where extreme differential pressures are needed.
- Produce clean, low-cost electricity.
- It is reliable, cost-effective electricity.
- To maximize electricity generation, several pipe systems can be installed into a single pipeline.

##### 5.2 Limitations

- Required a perfect designing of spherical turbine otherwise it goes to back flow the water.
- Initial cost is required.

##### 5.3 Applications

- Green electricity applications include wind turbines and water turbines used in applications for wind power and tidal power.
- Also it applicable in the village or city water supply lines.
- Dam out let pipe is the big source of this project.
- Farming water supply through the pipe is the great application for installation of this project because India is the farming country.

#### VI. FUTURESCOPE

The possible area of utilization:

- On the hilly areas the higher pressure head is easily obtained due to the altitude. And the velocity of the fluid is more due to the gravitational acceleration.
- The multi-store building, where the water almost flows constantly the overhead tank is filled and emptied very frequently in the buildings and the apartments. Hence we get almost continuous flow, which can be a great help in generating the electricity. The general purpose lightings of the building can be lit up by the stored energy.
- The government water distribution pipes for the different areas of a country Big pipe lines, used in the government projects for supplying the water to the dry areas of a country have also a large potential for this application.
- Agriculture and industries the water is the primary need of the agriculture and the industries. The turbines can be installed in the pipelines with sufficient diameters in these fields.

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