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<b>1.</b>	<b>Action Research Project No.</b> <i>(as assigned by PRTD)</i>	AR/0064
<b>2.</b>	<b>Title of the Action Research Project</b>	Basic Requirements of Automatic Water Level Controller for Tanks
<b>3.</b>	<b>Name &amp; Designation of Officer</b>	Arka Saha, Sc-C
<b>4.</b>	<b>Employee No.</b>	066079
<b>5.</b>	<b>Deptt./BO/RO &amp; Place of Posting</b>	JDBO, ERO
<b>6.</b>	<b>Date of Approval of the Project</b>	11 May 2020
<b>7.</b>	<b>Objective of the Project</b>	Draft the basic requirements of Automatic Water Level Controller for Water Tanks.
<b>8.</b>	<b>Report of Action Research Activities</b>	Report enclosed herewith.
<b>9.</b>	<b>Conclusion &amp; Recommendations</b>	Based on the formulated Basic Requirements, the specific requirements of the parameters and methods of testing for Automatic Water Level Controller for Tanks may be determined by the standard formulation Committee following which the complete draft product standard may be prepared.
<b>10.</b>	<b>Any other relevant information</b>	Nil

**(Arka Saha)**  
**Sc-C, JDBO**

**H (JDBO)**

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# **Report of Action Research**

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## **Basic Requirements of Automatic Water Level Controller for Tanks**

By

**Arka Saha**

Scientist-C

Jamshedpur Branch Office

## **Background**

Water scarcity is a problem that is gripping almost all the major cities of India. The main culprit is not alone availability but also undue wastage. One major factor contributing to this wastage is the overflow of Overhead Tanks. A Study suggests that more than 60% of supply water actually used is wasted due to Overflowing of Tanks. This wasted water could have been used to supply 60% more households if the wastage can be minimized. Additionally wasted Water indirectly means wasted energy as the energy that has been spent to pump the water is wasted.

One such Device that can be used to eliminate these wastages is the Water Level Controller. The device has the capability to monitor the water levels in both overhead Water Tanks and Underground Reservoir and accordingly automatically start/stop pump(s) as per the predetermined/programmed logic.

In addition to eliminating the wastage of water and electricity it also reduces the human effort and costs involved with it.

## **Objectives**

The objectives of this Action Research is to draft the requirements of Automatic Water Level Controller for Water Tanks based on the requirements of the users and inputs from the manufacturers.

## **Review of Literature**

Three International Journal articles on the subject were studied.

Manuals of the product from some of the manufacturers were Studied.

## Customer Survey

After an extensive discussions with various interested users, it was understood that the following are the requirements of the end users.

1. **Automation** : The Most important requirement of the interested users are to eliminate the costs of employing manpower traditionally required for monitoring of water levels and operation of pumps.
2. **Continuous Monitoring** : Another important requirement of the consumers are continuous monitoring of the water level in Overhead tanks to prevent them from becoming empty whatever be the outflow.
3. **Eliminate Wastage of Water and Electricity** : Wastage of Water by way of overflow of Overhead Tank and additional electricity consumed for pumping of this overflowing water has to be eliminated.
4. **Safety** : The Product should act as a safety device for the expensive pump set by preventing situations like dry run which have been traditionally known to damage pumps.
5. **Maintainance Free** : The Product should be Maintenance Free to the maximum extent possible so that the primary requirement of reduction in manpower is not defeated.
6. **Remote Monitoring** : The User should be able to manually monitor the Water Level in tanks (both Overhead and Underground) if desired without having to physically access the location of the tanks which are generally difficult to access.
7. **Multi Tank / Pump / Sump Systems** : Nowadays most Apartment Complexes / Offices etc have multiple Tanks, Sumps and Pumps to provide for maintenance / cleaning without interruption of their services. The product should also have provisions for such varieties of the product also.
8. **Special Requirements** : Standard for the product shall have provisions for special Requirements like integration with smart energy meters to reduce energy costs.

## Market Survey

From Internet search of the product it was observed that a number of manufacturers are engaged in the manufacturing of Automatic Water Level Controller for Water Tanks.

It was also observed that a number of varieties of Automatic Water Level Controller for Water Tanks is available to meet the requirements different customers at competitive prices. To name a few, varieties were categorized on:

- Only Overhead Tank Control / Both Overhead Tank and Sump control

- With and without displays

- For single phase / 3 phase pumps

- Type of starter (Simple Switch / DOL / Submersible Starter)

- Type of Water Level Sensors (Contact Type / Float Type)

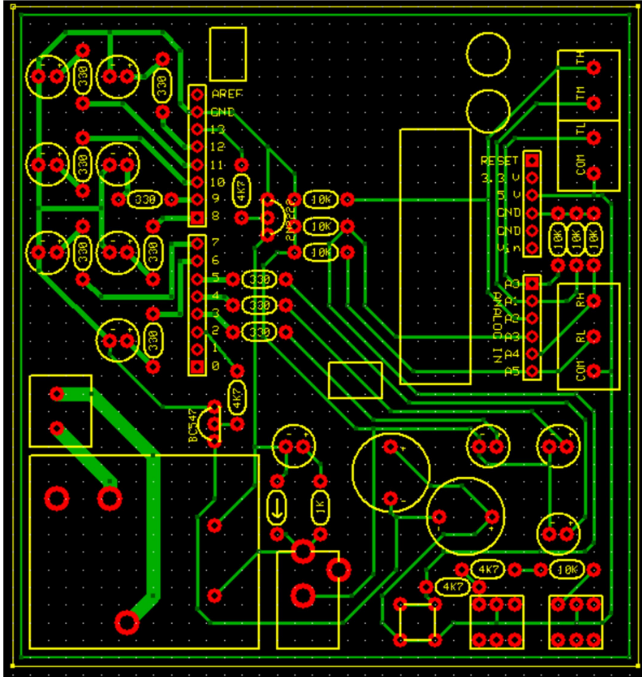
- Rating of Pump (Capacity)

- Etc

Also to meet the requirements of the customers the manufacturers have incorporated a number of features in the product Like Dry Run protection, Locked Rotor Protection, Overvoltage and undervoltage protection, etc.

## Prototyping and Testing

A simple prototype of the product was produced using basic electronic components and Arduino Uno Board and tested. The Board layout of the prototype is given below



From designing the prototype, all the possible varieties of the product with their own advantages and disadvantages were understood.

The device was observed to operate automatically satisfactorily for about 70 days before its failure which was attributed to corrosion of the electrode type sensors due to electrolysis.

# Product Varieties

## 1. Type of Operations

- a. Fully Automatic (Only Tank / Tank and Sump Level Detection)
- b. Semi Automatic (Only Tank / Tank and Sump Level Detection) with manual pump start and automatic stop
- c. Timed operation (Only Tank / Tank and Sump Level Detection)
- d. Any combination of the above options

## 2. Type of Liquid Level Sensors

- a. Conductive Liquid Contact Type Sensors
- b. Float type Sensors / Switches
- c. Capacitive Sensors
- d. Pressure Sensors
- e. Ultrasonic Sensors

## 3. Type of Pump(s)

- a. Single Phase
- b. Three Phase

## 4. Type of Starter

- a. Simple Switch
- b. DOL Starter
- c. Submersible starter

## 5. Pump Rating

- a. Upto 0.5 KW
- b. Upto 1.5 KW
- c. Upto 5 KW, etc

## 6. Protections

- a. With / Without Locked Rotor Protection
- b. With / Without Overvoltage Protection
- c. With / Without Low Voltage Protection
- d. Sensor Disconnection Detection

## 7. Indicators

- a. Number of Tank Level Indicators
- b. Number of Sump Level Indicators
- c. Abnormal Operation Indications
- d. Digital Display incorporating any combination of the above

## 8. Special Options

- a. Manual Operation option
- b. Sump Inflow Valve actuation
- c. Smart Meter Integration Options
- d. Multi Tank / Multi Sump / Multi Pump Options

## Requirements

Based on the inputs from the Consumer Survey, Market Survey, Manufacturer Interactions and Prototype development and Testing the basic requirements of the product were drafted. They are as follows:

### Mandatory Requirements

1. Product should operate satisfactorily at the permissible limits of distribution voltages.
2. Normal Operation Requirements
  - a. Fully Automatic
    - i. Start Pump only if Water Level in Tank is lower than the predetermined Low Level (Empty Tank Prevention) and Sump is not Empty (Dry Run Protection\*)
    - ii. Stop Pump if Tank is full (Overflow Prevention) or Sump is Empty (Dry Run Protection\*)
  - b. Semi Automatic
    - i. Manual starting
    - ii. Stop Pump if Tank is full (Overflow Prevention) or Sump is Empty (Dry Run Protection\*)
  - c. Timed Operation
    - i. Start Pump at the pre-set start time(s) and Sump is not Empty (Dry Run Protection\*)
  - d. Stop Pump at the pre-set stop time(s) or if Tank is full (Overflow Prevention) or Sump is Empty (Dry Run Protection\*)  
*\* Not applicable for only Tank Level Detection Controllers.*
  - e. If any controller has options for multiple of the above it should satisfy the requirements of each separately with the appropriate settings.
3. Sensors should not be affected by the liquid in which it intended for use. Sensors shall also not affect the liquid in which it intended for use.
4. Controller using Contact type sensors should be electrolysis free in the liquid in which it intended for use.
5. Controller shall be provided with Manual Operation option for special situations when the pump is required to be turned on irrespective of the detected water levels.
6. In Normal Use, there shall be no overheating of the controller when used with pumps upto which it is rated for.
7. Controller shall be installed with the appropriate type of starter.
8. Suitable indicators in the form of LEDs or Displays shall be available for remote monitoring.



9. Provision to Emptying Overhead Tank and / or Sump shall be provided. This shall be useful for activities like their maintenance.
10. Multi Tank Controllers shall be provided with tank inflow valve control to cutoff the water flow into the tank which becomes full earlier. The device shall also be able to cutoff water flow into any tank if maintenance is required on the same. Any other requirement may be included subject to agreement between manufacturer and purchaser.
11. Multi Sump Controllers shall be provided with sump outflow valve control to cutoff the water flow from sumps in case one of the sumps is full so that wastage of water by overflow of sump is prevented. The device shall also be able to empty a specific sump without draining any of the other sumps if maintenance is required on the same. Any other requirement may be included subject to agreement between manufacturer and purchaser.
12. Multi Pump controllers shall be able to run all pumps in rotation or together as required by the type of installation. I shall also be able to isolate any specific pump for maintainance. Any other requirement may be included subject to agreement between manufacturer and purchaser.
13. Manual with instructions for installation and use shall be provided with the product.

### **Optional Requirements**

1. Controllers with Locked Rotor Protection shall detect the Higher Current outflow due to Locked Rotor of the pump and stop the pump to prevent fire hazard and damage to the pump.
2. Controllers with Overvoltage and/or Low Protection shall be able to detect input voltages higher or lower (as applicable) than the permissible supply voltages and prevent operation of the pump to prevent it from damage and other hazards
3. Controllers with Sensor Disconnection Detection shall be able to detect all possible sensor disconnections to prevent erroneous operations. E.g. if the common of contact type sensors are disconnected the tank would be read as empty and pump would be kept on by the controller till it is manually switched off.
4. Controllers may be provided with Sump Inflow Valve control to prevent the wastage of water due to overflow of sump. If this provision is provided the valve shall shut off if the sump is full and remain open otherwise.
5. Controllers may also be provided with Smart Meter Integration. Such Controllers shall be able to receive data from the smart energy meters regarding current energy cost and operate the pump when the electricity costs are low till the tanks are full. This will ensure maximum utilization of the low cost electricity.

## **Conclusions**

Based on the formulated Basic Requirements, the specific requirements of the parameters and methods of testing for Automatic Water Level Controller for Tanks may be determined by the standard formulation Committee following which the complete draft product standard may be prepared.

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