Recondition Of Flood Pumps and Sludge Pumps as Effort To Increase Fluid Flow Pressure

Dea Argita Gunarso[1], Luwi Adi Riswanto[2], Farid Mujayyin[2]

{ deaargitagunarso690@gmail.com[1] , luwiadi@gmail.com[2], faridmujayyin@gmail.com[3]}

Community Collage Cement Indonesia[123]

Abstract. Even the pump house guards or workers must be on standby in dealing with this hydrometeorological disaster. One of them is the existence of flood prevention infrastructure such as pump houses. Pumps have to accelerate water transfer from puddles to the sea or river. A reliable standard pump can suck 1,5 m3/second. Very different from the current condition of the pump house, after being surveyed and inspected, its suction capacity is only 0,5 m3/second. The research method used to restore pump performance uses the ISMO (inspection, minor repair, medium repair overhaul) maintenance method. It is necessary to identify the damage to the pump and carry out maintenance of all components that have less than-optimal functions. The results of the maintenance implementation stage and the inspection results require periodic cleaning, repairs to the nearest drainage filter and a setting on the pump. At the same time, the overhaul activity is carried out by dismantling the installation's shaft, bearing, and impaler components. In contrast, the discharge nozzle requires setting the fluid pressure to increase to 1,3 m3/second.

Keywords: pumps, maintenance, setting.

1 Introduction

According to the BNPB, the geohydrological conditions on the island of Java and its surroundings are flood-prone because the average amount of rainfall in Indonesia is very high. In order to overcome the problems of environmental and water management, solutions to overcome flooding and flood inundation sent from various water flows and waterlogged areas due to malfunctioning of the drainage system that interferes and/or harms the community [1]. The volume of water pumped per unit of time is expressed in liters/second or m3/minute. A pump house is built to accelerate the transfer of water discharge so that it can quickly flow into the sea or the river and accelerate the application of puddles in flood-prone areas. Maximum discharge from a drainage system based on a specific return period used in areas that drain rainwater into receiving channels of natural or artificial water containers such as seas, rivers, lakes, retention ponds, detention ponds, and reservoir ponds. Based on a survey at the location of the pump house, there are three pumps. Two pumps function to suck water while the other is to suck mud. Usually, the capacity of a pump that sucks water has a suction

IConVET 2022, October 06, Singaraja, Indonesia

DOI 10.4108/eai.6-10-2022.2327431

power of 1,5 m3/second, while a pump that sucks in mud has a suction power of up to 0,5 m3/second. However, the presence of a water suction pump is only capable of 0,5 m3/second in a slurry pump under normal conditions. In order to increase the suction capacity of the water pump, maintenance and reconditioning of the pump, setting the valve to regulate the speed of fluid pressure, is also very much needed. Steps to repair the centrifugal pump in the anti-flood pump house must be carried out in stages. So that information on the steps to repair the centrifugal pump in the pump house can be known. The pump preventive maintenance method uses inspection, minor repair, medium repair, and overhaul approaches.

The pump is a fluid mechanical equipment that moves or raises the fluid by pushing it directly or converting mechanical energy into compressive energy or kinetic energy that can suck fluid from one place and emit it to a proper place. In pumps, by converting mechanical energy into fluid compressive energy, the energy conversion can be done in several ways, including using a blade or impeller, the reciprocating motion of the piston, gas or liquid intermediate fluid, and high-pressure air or gas. Calculating the volume of flow discharge (outflow) as a function of the volume of inflow (inflow) average pumping and storage. Efforts to maintain the condition and function of the pump and prevent the occurrence of things detrimental to the pump and pump equipment and facilities, whether caused by humans, animals or natural processes. This type of drainage pump moves water from a lower-elevation drainage area or channel to a receiving water body with a higher elevation. It is usually needed in tidal areas, estuaries or basins. Meanwhile, the slurry pump, placed in the pump pool (pump sump), functions to suck water and mud to clean the pool from silt deposits that can interfere with the pump's functions.

2 Research Methodology

The research design uses an experimental design sequence with a survey stage at the location of the drainage channel at the pump house consisting of a complete building. There is a generator, panels, flood pumps, and operating and maintenance rooms. The survey was conducted to ensure the flow process or the flow of the pump work system so that standardization can be easily determined by the operational standards of the pump house in accelerating the absorption and transfer of water flow from urban drainage channels to seawater through the pump house and flooded rainwater is quickly transferred to the sea.

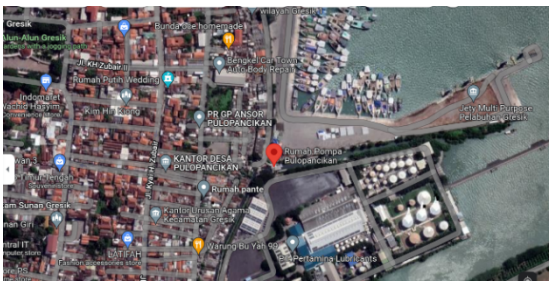

Fig. 1. Location of drainage channel and pump house

Observations were made to determine the pump house technology's existing condition and study the literature. Data retrieval with the stage of inspecting the equipment for the flood pump house and the mud pump. Checking the condition of the performance of the centrifugal pump technology equipment in the anti-flood pump house with test equipment in the form of a pressure gauge, tachometer, vibration meter, and shaft alignment tool. After inspection of the condition of the pump house. Implement and require the implementation of preventive maintenance on all anti-flood pump house equipment [2] ;

1. Inspection of all equipment components in a pump housing
2. minor repairs/light repairs on pump housing components that have been damaged by flooding
3. Medium repair/medium repair on pump housing components that have suffered significant damage, the level of damage,
4. Carry out an overhaul or a total repair of the pump housing due to severe and comprehensive damage. The results of initial checks or inspections on machine tools and components of the pump house have obtained several technological components used in the pump house. While the data analysis was measured, the analysis of the examination results was carried out using a qualitative descriptive approach accompanied by a quantitative one according to the results of the fact in the field. There is a pump house consisting of flood pumps 1 and 2 and sludge pumps, a generator room, an electrical panel room, a flood pump junction box, lighting panels, PJU panels, water drainage doors, guard room panels and guard house rooms where the pump supervisors live to carry out the operation and maintenance of the pump so that the pump can operate as required and for environmental safety.

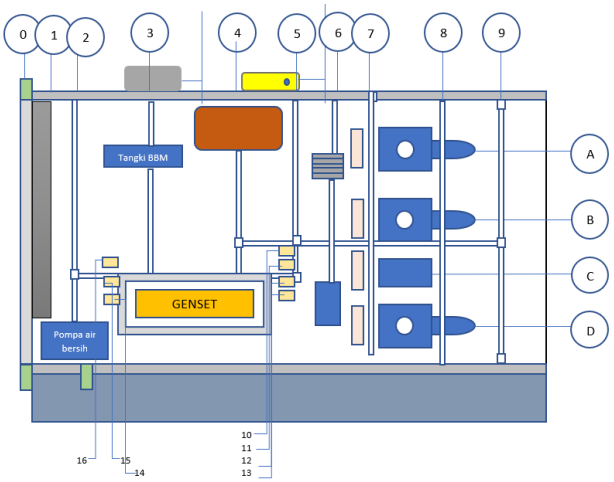

Fig 2. pump house lay out

In this experiment, several pump house equipment was determined to be used as objects as well as research samples, including :

No. 1 panel flood pump 1.0 m3/sec
No. 2 panel flood pump 1.5 m3/sec
No. 3 panel sludge pump
No. 4 panel flood pump 1.5 m3/sec
No. 5 Panel ATS and AMF
No. 6. Panel LVMDP (low voltage Main distribution panel)
No. 7 Junction box flood pump 1.0 m3
No. 8 Junction box flood pump 1.5 m3/second
No. 9 Junction box sludge pump
No. 10 Junction box flood pump 1.5 m3/second
No. 11 Box meter PLN
No. 12 Panel room lighting and generator room
No. 13 Panel PJU
No. 14 Operator guardroom panel
No. 15 SDP panels (sub-distribution panels)
No. 16 lightning protection panel

A. Flood pump capacity 1.0 m3/sec
B. flood pump capacity of 1.5 m3/second
C. slurry pump capacity 0.25 m3/second
D. flood pump capacity of 1.5 m3/second

The type of pump used as the primary sample of the research is the first flood pump gate components, including submersible pump, roller gate, actuator, flap valve, screen (rotary/hydraulic screen), belt conveyor, debris box and sluice gate. Applied to drainage channels with a minimum width of: 0.85-3.38 m with a minimum height of 1.0-2.25 with a range of Q (8-280) m3/minute [8]. Power output (Kw) 7.5 -400 Head (1.8-12 meters), of course, the quality of the material is corrosion resistant, the space is small and multi-functional, and there should be no garbage (water conditions must be clean), so that the gate can be closed and opened perfectly.

The pump gate construction used for the flood pump can be seen in the picture below.

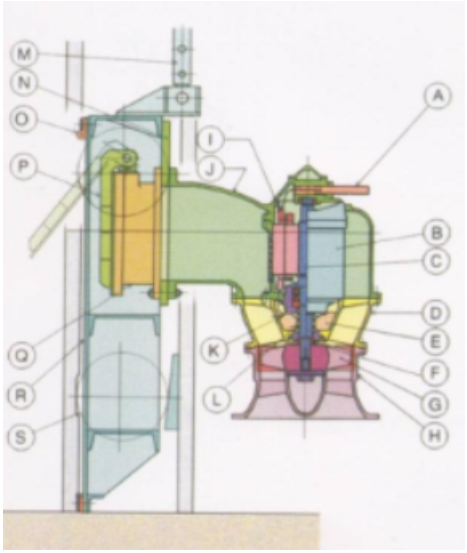

Fig 3. construction of a vertical shaft type pump gate

A. Cable holder
B. Motor frame
C. Main shaft
D. Discharge bowl
E. Rotor
F. Suction bowl
G. Thermal protector
H. Discharge casing
I. Water detector
J. Lube oil
K. Mechanical seal
L. Shaft sleeve
M. Spindle
N. Pump Mounting Plate
O. Seal Rubber
P. Flap Gate
Q. Flap Gate Body
R. Roller Gate leaf
S. Main Roller

Slurry and sludge pumps are submersible pumps with special specifications for pumping sludge. In installing a drainage pump system, the slurry pump is placed in the pump sump to clean the mud that can interfere with the function of the drainage pump. Sludge pumps are used to pump mud with a range of Q (200-500,000) gpm (0.757-1.892) m3/minute and H (20-150) ft, (6-45) m, and of course, the quality of the material must be corrosion resistant. The following design of the sludge pump is shown in the image below [5].

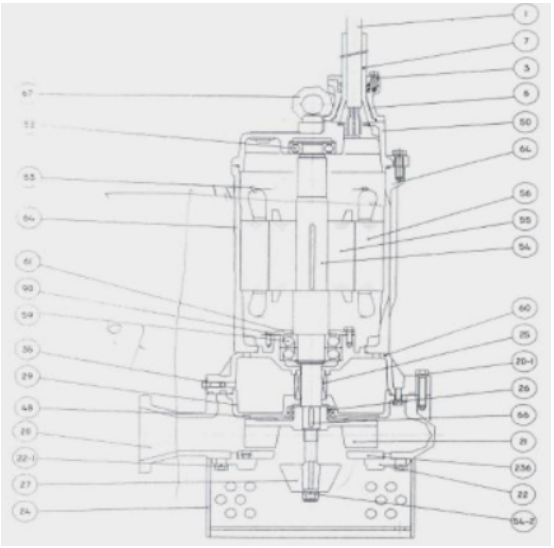

Fig 4. Slurry pump design

Description of the sludge pump components consist of
1 power cable
3 cable grand
6 suffing box
7 moulding tube
20 pump casing
20-1 bolt
21 impeler
22 suction cover
22-1 bolt
24 strainer
25 mechanical seal
26 oil seal
27 agitator
29 seal chamber
35 oil plug
48 impeler back plate
50 motor bracket
52 ball bearing
53 motor protector
54 shaft
54-2 nut
55 rotor
56 stator
59 ball bearing

60 bearing housing
61 bearing cover
64 motor frame
66 key
67 Eye bolt
90 seal sensor
236 suction cover disk

Tests after inspection, minor repair, medium repair and ISMO overhaul. The pump is tested for feasibility. The post-repair test ensures that the pump operation can work correctly, and the pump work system, according to the tolerance table, passed the test with the warranty points in the table and graphs that have been determined.

Table 1. Tolerance passed the test

Quantity	symbol	Class 1 %	Class 2%
Water discahrge	Q	±4.5	±8
Total height	H	±3	±5
efficiency	η	±3	-5

Verify the guarantee point of capacity, total height and efficiency

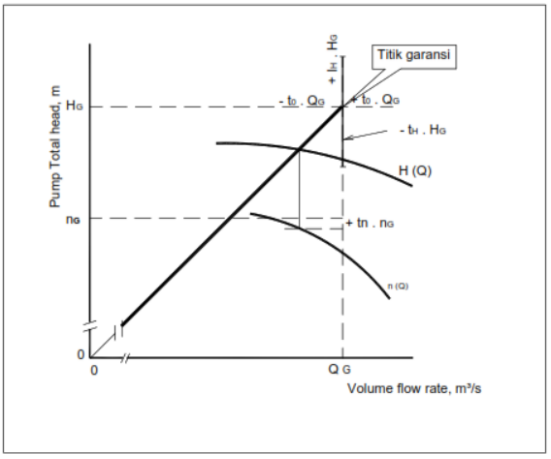

Fig 5. Total pump head on water discharge flow

Explanation
H = total height (m)
Q = discharge m^3/sec
H_G = total height at the point of warranty (m)
Q_G = discharge at the point of warranty (m^3/sec)
T_Q = discharge at the point of warranty (%)
t_H = total high tolerance (%)

t_n = efficiency tolerance (%)
nG = efficiency guarantee point (%)
The things that are considered for accuracy and reliability from the pump housing test in the field focus on the following:
a. ensure the pump operation is working correctly.
b. Ensure the pump's efficiency in the pump housing.
c. check the power supply.
d. check pump performance
e. use reliable and precise calibration of test instruments with several pump test items, including;
- measurement of head and standard atmospheric pressure, gauge head, maximum and minimum total dynamic head
- capacity testing
Volume and flow rate (volume/time)
- pengujian sumber listrik volts (unloaded), volts (loaded), arus listrik yang terukur ternasuk arus start, 100 % load current penuh.
While testing through field observations as follows:
a. alignment of pump and driver
b. the direction of pump rotation
c. connection of pump with power supply
d. operation of stuffing boxes and lubricant system
e. wearing ring clearance

Some of the measuring tools used during testing are as follows
a. vacuum gauge
b. pressure gauge
c. shaft power measurement
d. rotation speed measurement
e. time measurement (stopwatch)
f. measuring bulkhead discharge measuring instrument (weir)

Calculation of the specific speed pump using the equation:

$$N_s = \frac{n\,Q^{1/2}}{H^{3/4}} \quad (1)$$

While the determination of NPSH consists of several calculation steps namely,

Cross sectional area (As)

$$A = \frac{1}{4}\pi d^2 \quad (2)$$

The total head calculation from the head speed is

$$h_V = \frac{V_d^2 - V_s^2}{2g} \quad (3)$$

While the head pressure calculation uses the formula

$$h_p = \frac{p_d - p_s}{\gamma} \quad (4)$$

Overall total head value with equation

$$H_{total} = \left(Z_d - Z_s + \frac{p_d - p_s}{\rho g} + \frac{v_d^2 - v_s^2}{2g} \right) + \Sigma h_{f\,(d-s)} \quad (5)$$

Pump capacity can be calculated using the formula

$$Q_p = Q/(24x3600xD) \quad (6)$$

Where :
Q_p = flood pump capacity (m^3/sec)
D = Allowable inundation time (hours)

The description of the explanation of the research object emphasizes processing the measurement results, tables and graphs so that the objectivity of the research results can be archived systematically in detail, testing the capacity of the do not flood drainage pump in the pump house.

3 Findings and Discussion

The pump house has various methods and characteristics of the capacity and pumps head that varies on the type of flood pump as a solution for flood disaster control. This type of flood pump is an axial type. The pump will turn on automatically when the water is at a certain volume. The pump then sucks all the water from the reservoir to the nearest water line. The maximum work of the pump is very influential on the flow of water that can be sucked in. If only one pump dies. If only one pump dies, the flow of water that can be flowed will decrease before 2 flood pumps experience setting errors, damage to drainage filters and other technical problems due to damage by heavy drainage currents mixed with garbage [4].

The results of mechanical work on critical or critical parts of the mechanical pump system have been treated with the ISMO method (inspection, minor repair, medium repair, and overhaul) to increase all components that lack optimal function based on their level of reliability. Several efforts and improvements were made as a maintenance process on equipment with a focus on restoring the performance of the pump suction power quality so that water that inundated urban areas due to flooding in water drainage channels near the pump house could be easily moved upstream or to the sea [4].

Inspection of the pump house can be easily seen that the flood pump, slurry pump and filter need gradual repairs so that the performance of the pump housing has optimal capacity. The inspection activity begins with a review of the pump installation at the beginning of the pump house project being built, supervising the installation process as recommended (foundation, welding results, testing over speed and trips, checking emergency equipment and conducting tests and checking the function of the tool, rotation of 1500 rpm, pressure (head) of 15.6 m3c / sec suction (head) pressure of suction, discharge NPSH namely checking the required power on the suction and discharge parts of the pump during operation [7].

Light maintenance and medium repair activities with several settings and dismantling of the main parts of the flood pump in the pump house, including on the main pump;
a. installation of overhead crane and real beam
b. installation of the suction pipe (column pipe), exhaust pipe, ADC guide pipe and other accessories
c. valve installation; butterfly valve, flap valve.
d. drainage pump installation
e. installation of reducing gear (gear change rotation)
f. installation of guide ribs if needed
g. pump drive installation (combustion motor, turbine electric motor) for axial type pumps, mixed with submersible type, the pump and electric motor are installed as one unit and placed in the column pipe (column pipe).

Activity in the drain pump reset settings include;
a. slurry pumps generally use submersible type
b. installation of exhaust pipes, valves and other accessories
c. installation of ADC / pump discharge elbow
d. guide pipe order
e. drain pump installation

Activity garbage filter and accessories ;
a. coarse garbage filter installation
b. fine garbage filter installation

Motorized garbage cleaning tools and tools ;
a. optimizing the use of junk cleaning tools.
b. power cable installation.
c. base frame and rail frame installation.
d. lubrication and painting of doors.
e. spindle installation gear axle.
f. support installation.
g. transmission gear lubrication.
h. installation of the door moves from the motor or manual
i. installation of door panels using electric motor drive

The maintenance activities for the drainage pump and other equipment components in the pump house have been carried out according to standard SOP. The drainage pump maintenance was previously tagged, and the outgoing / EP and incoming ICP panels, MCB was in the off / service supply position with a voltage of 567.1 volts, while the outgoing grounding panels were in the incoming position. The maintenance implementation is as follows.

- Disassembly of pump impeller parts, shafts, couplings, intake and exhaust pipes.
- dismantling parts/engine parts /generators
- cooling system, lubrication system, fuel system, exhaust pipe
- cylinder head, valve connecting rod
- disassembly of the pump motor, including the stator, rotor, cooling fan bearing
- replacement and repair of all damaged parts/parts
- realignment and measurement of all parts/pack

The test data results and measuring instrument reading instrument readings are presented in table 2 of the results of the total head calculation using equation (5). To protect against overpressure, install a pressure relief valve at the bottom of the pump head. The set point on the pressure relief valve must be 30 psi above the pressure setting. If installing a relief valve, it is recommended to connect with a suitable drainage point. Pumps are usually maintenance-free [9]. Deposits and wear can occur for that service tools, and service tools are available if warranty service is carried out to the service center service if it is still valid if the total head is not maximized.

The experiment's results on the highest water level profile of water crossing the embankment boundary showed that the simulation above showed that several drainage reservoir points were flooded. Therefore, to overcome this by using a flood pump setting so that the water level can be lowered, the modeling results show the following graph.

Table 1. calculation of the total pump head capacity 1

Inundation time (sec)	Water discharge	1 Flood pump head	Pump capacity 1
30	40,6	1,353	1,250
10	60,2	6,020	0,417
15	70,3	4,687	0,625
20	75,1	3,755	0,833
25	78,7	3,148	1,042
30	82,4	2,747	1,250
35	89,4	2,554	1,458
40	90,4	2,260	1,667
45	97,3	2,162	1,875
50	98,1	1,962	2,083

The flood pump head capacity in table 1 has increased at 7 water discharge conditions while the time needed is 50 seconds, so the pump capacity is 2,083 m3/second. This is because pump operation settings in practice are often required to change pump performance by adjusting the capacity and pump head both quantitatively setting n= constant requires setting the valve and discharge pipe, setting the valve on the suction pipe, making the by-pass flow from the discharge pipe to the suction pipe, and setting qualitatively n= changed by adjusting the pump, for example with a gearbox, an electric motor with an inverter, ideally, the larger the pump capacity used, the faster it will be in tackling the puddle that occurs [10]. The reference is to upgrade the capacity of the pump. Getting the flow rate of water discharge in the drainage is very reasonable.

Table 2. calculation of the total pump head capacity 2

Inundation time (sec)	Water discrahe	2 Flood pump head	Pump capacity 2
3	40,6	13,53	0,002
6	60,2	10,03	0,004
9	70,3	7,81	0,006
12	75,1	6,26	0,008
16	78,7	4,92	0,011
18	82,4	4,58	0,013
21	89,4	4,26	0,015
24	90,4	3,77	0,017
27	97,3	3,60	0,019
30	98,1	3,27	0,020833

The flood pump head capacity in table 2 has increased at 98,1 water discharge conditions while the time needed is 30 seconds, so the pump capacity has a capacity of 0,020833 m3/second. The reference is to upgrade the capacity of the pump. Getting the flow rate of water discharge in the drainage is very reasonable.

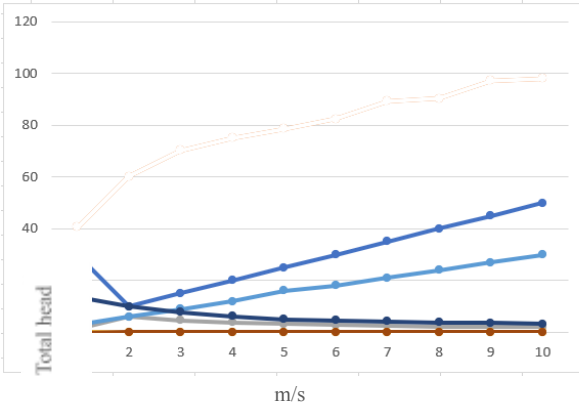

Fig 7. head condition and capacity before repair

In comparing the performance of flood pump 1 and flood pump 2 in the pump house, there are several differences in the value of the head and pressure on flood pump 1, which is almost 3.74 m in capacity. In contrast, flood pump 2 has a capacity of 5.76 m at the time of water disposal during inundation. Water enters the chamber or reservoir of the pump suction area.

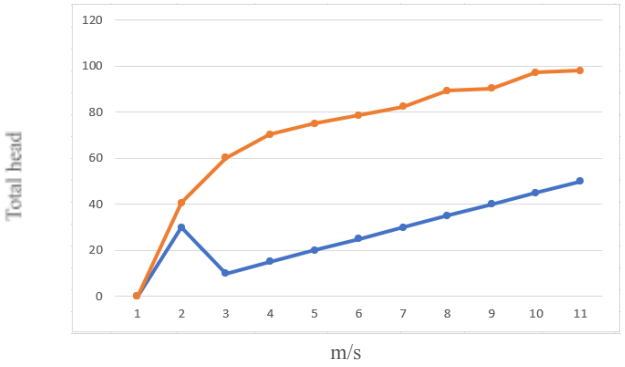

Fig 8. Head dan kapasitas pompa banjir 1

Local flooding in the affected environment and urban areas, as well as communities around watersheds leading to the sea, can be proven by calculating the capacity and pump head 1 seen in the flood control pump having characteristics of a large capacity reaching 60-90 at the maximum position while the head at low about 0.29 m3/sec. Because floods are seasonal, flood control pumps only operate occasionally. However, flood pump 1 in the pump house has worked optimally, so a reliable pump system solution is very rational and feasible. Meanwhile, the head and capacity of the second flood pump also have the same capacity as the flood pump one, only that there is an increase in the pump head, reaching 1.23 m3/sec, meaning that both have optimal performance. It is just that the water level varies from several measurements during the suction experiment due to pump one suckers first, and the puddles in the reservoir where the floodwater flows into the pump house can be quickly removed.

The discharge capacity produced is more than flood pump 1 and flood pump 2, because the mud pump shows the inlet pipe and outlet pipe of the mud pump. There are turning points and optimal points, and the mud pump's performance can work optimally to lift mud impurities. It is easier to raise the slurry fluid, which affects the number of valve strokes in a good performance with lower time. The advantage is that the slurry pump, lifting the mud dirt in the reservoir in the drainage water channel, lifts faster and produces the greatest efficiency.

4 Conclusion

The pump house requires regular maintenance on each component, both in flood pumps 1, 2, and 3 and mud pumps, so that the readiness of the pump, when needed, is in a state of readiness, especially during rainy season conditions. The pump house has an optimal contribution in preventing flood disasters from the performance of the pump house, which can operate to accelerate the water channel in the drainage to the sea. Collecting excess water and immediately dumping it with a pump with a large capacity and low head continuously, the flood hazard and flood management through improved operational services, pump maintenance and monitoring of pump guards, flood problems in urban waterlogging areas can be controlled.

References

[1] P.M. Risnadinata, I.N.S.Kumara, and W.G.Ariastina 2020 Management of flood protection system of dewa ruci underpass in bali. Journal of electrical, electronics and informatics, Vol. 4 No. 2, P-ISSN:2549-8304 e-ISSN:2622-0393

[2] Farid Mujayyin, Dea argita 2020 Improving the performance of TPA waste procesing technology into refuse derived fuels (RDF) with The Six Sigma DMAIC. E-journal.uin-suka.ac.id/saintek/icse. Volume 4. Issue science and technology. Page 78 ICSE UIN Sunan kalijaga jogjakarta.

[3] Nien Sheng Hsu 2015 Two stage pumping control model for flood mitigation in inundated drainage basins. Water resources management 28:425-444 DOI 10.1007/s11269-013-0491-0. Springer science +Busniness Media Dordrecht

[4] Boris Karlop Lubangaol, Agustinus Purna Irawan Wati A Pranoto 2022 Study Of Integrated Systems Pumps In Coast of DKI Jakarta, IJEBD International Journal of Entrepreneurship and Business Development Vol 5 No 3 (may 2022).

[5] Kusnan, Heri Suryaman 2019 Sustainable flood prevention using interconnection of House Pump System. International Conference on science and Technology. IOP Publising Journal of physics: conference series 1569 (2020) 042027 doi:10.1088/1742-6596/1569/4/042027

[6] Tanjung rahayu raswitaningrum, and bagus kusuma wardana (2021) Canal capacity in area sumur batu pump house-central jakarta. International journal of civil engineering and infrastructure vol. 1 No. 1 civil engineering IJCEI e-ISSN: 2776-2580

[7] Ehsan Farno, Nicky Eshtiaghi 2020 Pumping sewage sludge: A challenge for the future, Water e-journal article vol 4 (4) pp.1-9 Australian water association MIT University

[8] Viktor Andreevich Morozov, Aleksandr Viktorovich Morozov, Elena Nikolaevna Morozova 2017 Some aspects of calculation of joint operation ofsewage sludge pumps and pipeline networks, Journal of applied engineering science Vol 15 No. 3

[9] Gang Yuan, khim hoong chu, 2020 Heat pump drying of industrial wastewater sludge, article navigation water practice and technology 15 (2): 404-415

[10] Jiaju Ma, Eric R. Fossum 2015 Apump-Gate Jot Device With High Conversion a Quanta Image Sensor , IEEE journal Of The electron device society Volume: 3 Issue: 2, page 73-77 Electronic ISSN: 2168-6.