Optimizing the Construction of the NUWSP SPAM Piping Network in Gresik Regency

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Abstract. Water is essential for all living things, including humans. Water, both in terms of quality and quantity, will have an effect on human life. The Indonesian government is preparing the National Urban Drinking Water Supply Plan (NUWSP) with assistance from the World Bank. A significant portion of the Bank's financial resources are allocated to technical assistance and capacity building in support of the Indonesian government's infrastructure expenditures in all urban water distribution platforms. The NUWSP Work was implemented during an 11-month period, from November 18, 2021 to August 22, 2022, with the NUWSP Work Location at Gresik Regency in East Java. During the data collection stages, both primary and secondary data were obtained. The drinking water supply system (SPAM) planning stage comprises calculating BOQ and RAB, as well as DED for drinking water, and planning for the drinking water JDU system. The contractor takes measurements and standards before installing a field-specific bow plank at the tying point. To avoid pipe damage, individual pipe fittings must be lowered into the trench using the right equipment. The volume of excavation is computed using a depth of 180 cm, a breadth of 60 cm, and a length of excavation of 31 km from six pieces of a pipeline. The Bill of Quantity (BOQ) and Budget Plan (RAB) necessary to complete the SPAM pipeline network work in Gresik Regency were IDR 27,823,590,000.00, based on the results and discussion of the Optimization of SPAM Network Work (NUWSP) in Gresik Regency.
Keywords: NUWSP, World Bank, BOQ, RAB, SPAM, JDU

1. Introduction

Water is essential for all living things, including people. Water is incorrect. Water is one of the most basic needs, both in terms of quantity and quality, and it plays a significant part in human life. It can be used for irrigation, forestry, industry, tourism, drinking water, and many other uses. [1] According to the Description of Republican Government Regulations Indonesia No. 16 of 2005, SPAM development is the responsibility of the regional government in order to realize public welfare by guaranteeing the underwater needs of public drinking water that are met with quality, quantity, and continuity requirements.[2] However, most local governments have historically lacked the capacity and political will to oversee the supply of water services. As a result, infrastructure, human resources, and building are underinvested. Inadequate institutional capacity building and regular service monitoring. Overall, dreadful.

As a result, the Indonesian government is currently in the Development Plan Period. Medium (RPJMN, 2020-2024) is currently oriented specifically at problem resolution. Basic infrastructure, such as the ability to offer universal access to water and sanitation. The Indonesian government initiated several initiatives to raise funds. Advances in the delivery of drinking water services that make better use of current resources (from central and local government programs and institutions, external funding, and private business participation). These efforts include developing tariff guidelines, debt restructuring PDAM, central government loan guarantees, and bank loan subsidies in the country with loans PDAM, as well as performance-based grants and allocation funds for other special services to local governments. [3] The Indonesian government has made investments in infrastructure and institutional development, with a particular emphasis on investment infrastructure. Institutional strengthening was done through a more diverse but less planned approach.

The Indonesian government also initiated the National Urban Water Supply Framework (NUWAS), a national roadmap that supports the development of water supply infrastructure in urban areas and facilitates innovative financing schemes. Through the NUWAS framework, the Government of Indonesia envisions efficient implementation of various urban water supply programs to expand access and build the capacity of local governments and their PDAMs to provide sustainable drinking water services. Based on these initiatives, the Government of Indonesia is preparing a National Urban Water Supply Project (NUWSP) with support from the World Bank (Bank) in 2016 to further develop and implement the NUWAS Framework as a project.

A relatively significant portion of the Bank's finances will be focused on technical assistance and capacity building to support the Government of Indonesia's infrastructure investments across urban water supply platforms. The Indonesian government is also seeking to use the World Bank's comparative advantage to demonstrate the creation of an enabling environment for total infrastructure investment financed from all levels of government and other funding sources, including public and non-public sources, within the country. [4]

2. Materials and Methods

2.1 Time and Location of Research

The duration of the NUWSP Work is 11 months, from November 18, 2021, to August 22, 2022. The NUWSP Work Location is in Gresik Regency, East Java.

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2.2 Stage of Work

Research planning is a systematic process. The planning step is divided into several steps including first preparation, second implementation, third analysis

2.3. Methods of data collection

The stages of data collection include primary and secondary data.

Table 1. Data Collection Method
Source: Analysis Results, 2020

Data Type	Name	Source	Collection Method	Numerical Data
Primary data	Data Tracking: Piping Plan path	Observation And measurement in the field	GPS and Total Stations	Pipeline length and ground elevation
Secondary Data	Unit price Wages and worker (HSPK) of Gresik Regency.	Government of Gresik Regency	Data retrieval from Government of Gresik Regency	HSPK for BOQ determination and RAB

2.4. Data Analysis

Based on the analysis that has been carried out, several steps were taken in the implementation stage of the drinking water supply system (SPAM), including the drawing of the drinking water distribution system (DED), the shop drawing network, and the calculation of the total billing and budget plan (RAB).

3. Results And Discussion

In the work of the Drinking Water Supply System (SPAM), it is necessary to have a planning analysis. It is important to carry out any planning analysis during the operation of the Drinking Water Supply System (SPAM). In order to understand the physical condition of the affected area, this is being done. This planning area analysis is based on information obtained from field surveys. This information will be used as the main measurement tool in the Gresik Regency SPAM Network Development Optimization Project (NUWSP). The survey was conducted in the regions using population analysis and pipelines. Occupation Analysis in this Work with the Assistance of Surveillance of the Number of House Connections (SR), Public Facilities (fasum), and Outreach tracking the road using the Garmin 64s GPS unit, tracking the pipeline path during this planning GPS can generate coordinate data and elevation updates for each node or intersection. According to SNI 7511:2011 procedures for installing Distribution and Transmission Pipelines, this data can be used as a starting point for a pipe excavation database.

3.1. *Distribution Pipeline Analysis*

Pipeline distribution channels are analyzed to obtain the necessary data to be used in planning the optimization of the main distribution pipe network of NUWSP SPAM. The data is in the form of a suitable pipe and the residual pressure in the pipe. This work uses manual calculations used to distribute water and other resources in water-scarce areas, and then water hydraulic modeling is used to simulate the effects of water shortages on the distribution system using Epanet 2.0 as a comparison to manual calculations of distribution pipes.

Pipeline excavation data will be used for pipe head and elevation data and the calculation of residual pressure. [5] The general description of the location for the construction of the Gresik Regency SPAM piping network is shown in Figure 1.

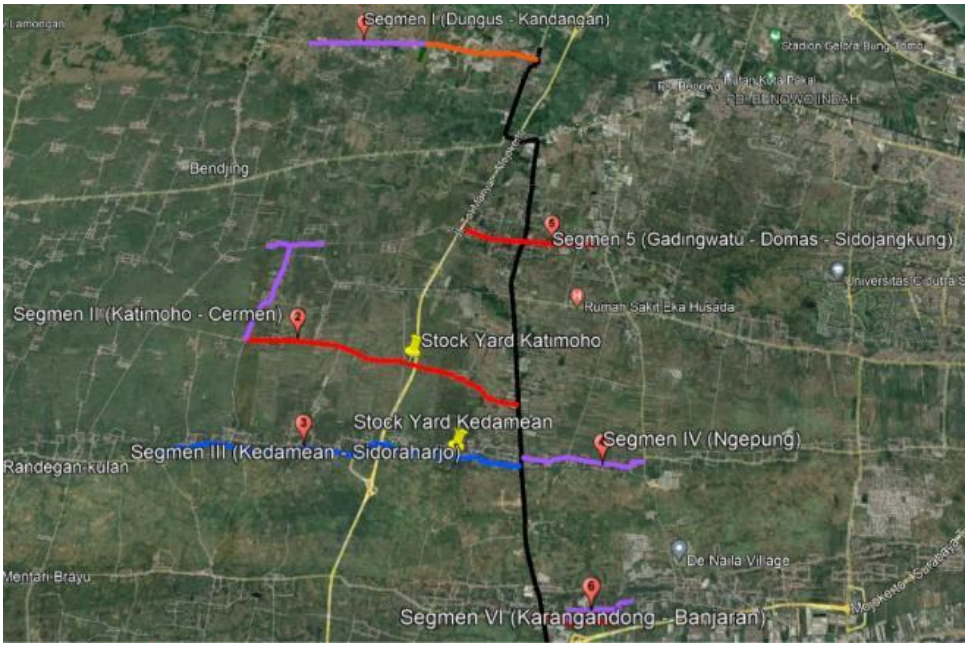

Fig. 1 Map of the NUWSP Pipeline Development Network

The selection of pipe types and materials in the work of optimizing the construction of the NUWSP SPAM pipeline network is based on several aspects, including budget, roughness coefficient, and pipe durability. In addition, the implementation of this work uses HDPE (High Density Poly Ethylene Pipe) Pn 10 type pipes. This pipe was chosen because it is made of high-density polyethylene material with a compressive strength of up to 10 bars. HDPE pipes also have TKDN certificates. The following is the TKDN Certificate in Figure 2 [6].

No. Sertifikat		1556/SJ-IND.7/TKDN/XII/2011 Sertifikat ini sudah Expired.
Tanggal		24 Desember 2011
Hasil Produksi		PIPA POLYETHYLENE
Kode HS		
No Referensi		PTKDN - 1100591
Sertifikat BMP		No. 30/SJ-IND.8/BMP/VI/2022
Nilai BMP		3.75%
Verifikator		PT. Sucofindo
Jenis Produk	:	Pipa Hdpe Pe 100
Merk dan Tipe	:	INDOPIPE
Spesifikasi	:	OUTSIDE DIAMETER I 63 MM, PN 10, SDR 17
Standard	:	SNI 06-4829-2005, LSPro PUSTAN KEMENPERIN, BERLAKU S.D 11/02/2014
Nilai TKDN	:	21.22%

Fig. 2 FAT pipe at Indopipe Gresik factory
Source: TKDN.Kemenperin.go.id

3.2. Pipeline Water Pressure

When distributing water, it is very important to pay attention to residual pressure. This will help maximize the service. The lowest residual pressure is at 5 mka (meters of the water column), and the highest is at 5 atm, or the equivalent of 50 m. Use the equation as follows:

$$P = \rho \times g \times H \quad (1)$$

$$P = 1000 \times 9.81 \times 40$$

$$P = 392.400\ N/m2 = 3.87\ atm = 38.7\ m$$

3.3. Technical Specifications

Installation of pipes and procurement of main materials, equipment, and supporting materials that can support the performance of a good drinking water system illustrate part of the work being carried out in implementing the construction of the main distribution network. The contractor takes measurements and benchmarks and installs a structured bouw plank around the approved drawings.

Apart from the Bouw plank, there is excavation, backfill, and compaction of the soil, which are related to the soil from the excavation, or maybe the excavation of the land can be used for the installation of distribution pipes and additional work for the water distribution system. [7]

Each pipe to be installed is strictly in accordance with the method and slope specified in the drawings and specifications. Pipe installations must be lowered one by one directly into the excavation to prevent damage to the pipe. The pipeline distribution network installation process starts with earthworks and goes through several steps:

1. Cleaning of the site or land field (land clearing)
2. Excavation process below proven surface soil.
3. Depth of excavation, depending on what has been agreed upon and the diameter of the pipe to be installed.
4. Making the top layer after the pipe is planted (backfill) and landfill

Following the planting and installation of network pipes, they are likened to accessories. It is critical that no dirt or other pollutants obstruct the flow of water in the plumbing network. Every pipe that has already been placed or put into the excavation must be quickly installed, the connections corrected, and the required material backfilled and compacted. The depth of pipe excavation must be changed in accordance with the design drawings shown in Figure 3.

JCEPD-ISSN: 2830-3628

Fig. 3 Depth of HDPE Pipe Excavation and HDPE Pipe Connection

The volume of excavated dirt is computed using a depth of 180 cm, a breadth of 60 cm, and an excavation length of 31 km made up of 6 segments. The sand fill is estimated for the height of the sirtu fill, which is 120 cm, and the aggregate type A is 30 cm high, and the excavation width is 60 cm on the piping line illustrated in Figure 4.

Fig. 4 Depth of HDPE Pipe Excavation and HDPE Pipe Connection

3.4. Hydrotest

The hydrotest is a test that is used to discover leaks in welded joints as well as to evaluate the stabilization of the load on the tank by admitting liquid (water) at the maximum level. When the tank is full, leak testing is performed on embedded HDPE pipes using atmospheric pressure (air). The hydrotest is performed by retaining water and air for approximately 3 hours to assess whether there is a leak in the implanted pipe at an approximate pressure of 8 bar. The hydrotest is completed in six phases, namely kedamean, katimoho, ngepung, domas, cerme, and Karangandong, in a matter of days.

Before conducting the hydrotest, ensure that the pipe installation work is completed in accordance with the design, specifications, and drawings related to the piping system, form a team or workforce for this hydro testing work, so that there is a person who is responsible for each task (performing authority), and all workers who carry out hydro testing tasks understand and understand the testing process and its safety factors [8] Ensure that prior to carrying out the testing work, the safety procedures have been followed in accordance with the Permit to Works (PTW), TRA (Task Risk Assessment), and HIT (Hazzard Identification), and have been approved by the person in charge testing the pipeline on Figure 5.

JCEPD-ISSN: 2830-3628

Fig. 5 Hydrotest implementation at the work site

A distribution pipe bill of quantity (BOQ) is a breakdown of the amount of material and pipe volume required for purchasing tertiary, secondary, and primary distribution pipelines. The Gresik district SPAM planning employs the Pn 10 HDPE pipe model, with diameters of 6 "(160 mm), 8" (200 mm), and 10" (250 mm). The volume of blowplank required for analytical preparatory work can be calculated using the width and length of the pipeline to be carried out. The following is the amount of planning done prior to the start of work:

Table. 2 BOQ of Pipeline Network Development

Work Unit	:	Settlement Infrastructure Center For East Java Region		
Work Unit	:	Implementation Of Settlement Infrastructure Region I Java Province		
Work	:	Development Of Gresik Regency Spam Network (Nuwsp)		
Long Plan	:	Segment I (Dungus - Kendangan)	Dia 160mm	3,050 Meters
	:	Segment II (Katimoho - Cermen)	Dia 200-160 Mm	10,706 Meters
	:	Segment III (Kedamean - Sidoharjo)	Dia 250mm	8,015 Meters
	:	Segment IV (Beach)	Dia 160mm	2,900 Meters
	:	Segment V (Gading Watu - Domas - Sidojangkung)	Da 200mm	3,306 Meters
	:	Segment VI (Karangadong - Banjaran)	Dia 200-160 Mm	3,689 Meters
Project Location	:	Kec. Cerme, Kec. Anti, Kec. Peace And Kec. Driyorejo		
Fiscal Year	:	2021 - 2022		

No	Job Description		Total Price
A	Preparatory Work		Rp 41,298,723
B	Segment I Jdu Pipe Installation (Dungus - Kandangan)		Rp 1,528,968,040
C	Segment Ii Jdu Pipe Installation (Katimoho - Cermen)		Rp 7,080,560,881
D	Installation Of Jdu Pipe Segment I (Kedamean - Sidoharjo)		Rp 8,997,435,713
E	Installation Of Jdu Pipe Segment I (Ngepung)		Rp 1,495,797,641
F	Segment I Jdu Pipe Installation (Gedung Watu - Domas - Sidojangkung)		Rp 1,971,564,947
G	Installation Of Jdu Pipe Segment I (Karangandong - Banjaran)		Rp 2,283,273,864
H	Procurement And Installation Of Pumps And Inverter In Legundi		Rp 1,406,081,211
I	Procurement And Installation Of Pump And Inverter In Tpi Booster		Rp 2,652,959,183
J	Smk3 Work And Covid.19 Prevention		Rp 416,630,000
		AMOUNT	Rp 27,874,570,203
		ROUNDING	Rp 27,874,570,000

The Construction Budget Plan (RAB) is extremely useful in ensuring that construction projects are finished on schedule and under budget. This document offers a full overview of a project's materials and task specifications. There are various procedures that must be completed in order to compute the RAB, including volume (Bill of Quantity), unit pricing analysis, and price recapitulation, as well as budget planning.

4. Conclusion

Based on the findings and discussions about the optimization of the work of the SPAM network (NUWSP) in Gresik Regency, the following conclusions can be drawn: The BOQ and RAB required to carry out the work of the SPAM pipe network in Gresik Regency spent IDR 27,823,590,000.00 on its implementation.

Citation: Latif and Kusuma (2023), Optimizing the Construction of the NUWSP SPAM Piping Network in Gresik Regency. *Journal of Civil Engineering, Planning, and Design Vol. 2, No.1,* Page 1-6

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