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## Application Of Crashing Method On Sutt Construction Project 150 Kv Kolaka - Pomalaa Switching - PT Antam Pomalaa Customer

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### ABSTRACT

Construction projects often experience delays that can result in a fine of 1/1000 of the contract value according to Presidential Regulation No. 54/2010. To overcome this, the crashing program method can be applied to accelerate the project duration by identifying and compressing the critical path. The case study on the 150 kV Kolaka - Pomalaa Switching - PT Antam Pomalaa SUTT Construction Project which experienced delays, analyzed the need for additional time, equipment and labor. With an initial contract duration of 300 calendar days, the implementation of the crashing program focused on four priority segments of work (TIP 40-54, TIP 01-11, TIP 23-40, and TIP 11-23). The results of the analysis showed that the application of the crashing program method successfully optimized the project completion duration to 263 days, allowing the project to return to the contract schedule and avoid potential fines.

## 1. Introduction

PT PLN (Persero) is one of the State-Owned Enterprises (BUMN) in Indonesia that runs its business in the electricity sector from the downstream to the upstream sectors [1]. In line with one of the missions in the asta cita of President of the Republic of Indonesia Prabowo Subianto, namely continuing downstream and industrialization to increase added value in the



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country, PT PLN (Persero) is present in supporting the downstream process in the mining industry sector by providing electricity for the refining process of mining products in Smelters operating in Indonesia [2].

Along with this, PT PLN (Persero) has signed an MoU with PT Antam, Tbk. on the Sixteenth of January in the year Two Thousand Twenty-Three (16 - 01 - 2023) as stated in the SPJBTL (Electricity Sales and Purchase Agreement). This explains that PT Antam, Tbk. will use National Electricity in order to support the Ferronickel ore production process at the Pomalaa Smelter with a power amount of 150 MVA with a rated voltage of 150 kV. Furthermore, the completion of this MoU is translated into an electricity infrastructure project contract, namely the construction of the 150 kV Kolaka - Pomalaa Switching SUTT - PT Antam Pomalaa Customer with the PT PLN (Persero) Southeast Sulawesi Project Implementation Unit which will become the Director of Work.

Along with the implementation of the completion of this project, there was a deviation in the delay of the work. In July 2024, amounting to - 3.3899 % (Negative Three Comma Three Eight Nine Nine Percent) so that strategic steps are needed to catch up on the delays in work in the field. There are several main factors that cause delays in the completion of this project, namely social problems to the geographical conditions of the project location which are spread into several transmission tower points and have different problems [3].

This study will use the MS Project 2007 program application to determine work *items* that are on the critical path and apply *crashing steps* in controlling project completion delays. The *crashing steps* that are the aim of this research are to increase the number of *manpower* and work tools to obtain the optimal duration in completing the project [4].

The author's reason for choosing this title is based on several factors, namely efforts to obtain potential profits. PT PLN (Persero) amounting to 107 billion Rupiah every month and avoid delays in project completion which can result in a fine of 36 billion Rupiah every month in accordance with the SPJBTL (Electricity Sales and Purchase Agreement).

Some of the research results that have been conducted on project implementation using the crashing method include the following [5]:

- a. Noviani (2021) conducted a study entitled "Optimization of Project Implementation with the *Crashing Method* Using Microsoft Project Software (in a case study of Procurement of New Negative Pressure Isolation Room Construction - Karimun Regency, Riau Islands Province) [6]" in this study the author obtained optimization results using the *crashing method* by adding working hours to complete the project work.
- b. Elisabeth Riska Anggraeni (2016) conducted research with the title "Project Acceleration Analysis Using the *Crashing Method* with the Addition of Labor and Work Shifts (Grand Keisha Hotel Development Project Yogyakarta)" [7] calculations on *crashing method* using the method of accelerating the addition of manpower and *work shifts* so that it can reduce the duration of work completion.
- c. Marselinus Yanuar Poerba (2022) conducted a study entitled "Acceleration Analysis Using the *Crashing Method* on the Bali House and Clinic Construction Structural Work Project (Bali House and Clinic Construction) [8]" in this study the author obtained acceleration results by adding the number of workers are more optimal to do, because it produces costs and duration which is smaller than the acceleration alternative by adding working hours.
- d. Blessing of Rama Bayu Adi (2016) conducted research with the title "Analysis of Project Acceleration Using the *Crash Program Method* (Construction Project for the Regional General Hospital of Serang Regency - Banten) [9]". In this research, the author obtained acceleration results by carrying out calculations. *crashing* with several job scenarios in the field so that the optimum duration and costs are obtained in completing the project.

## 2. Research Method

This research is a quantitative descriptive research, because in this study it tries to describe a project scheduling optimization phenomenon, project activity characteristics, and cost–time relationships factually, systematically, and accurately. The method used in this research is document analysis combined with project scheduling simulation [11]. In quantitative research, document analysis is carried out by collecting and reviewing project documents, then processing the data using project management software to assess the effects of schedule acceleration. The phenomenon in this article is the application of the crashing method to accelerate the SUTT 150 kV Kolaka–Pomalaa Switching - PT Antam Pomalaa Customer construction project. Data sources are data sources that directly provide data to researchers, namely parties involved in the SUTT Kolaka- Pomalaa project. The sampling technique used is purposive sampling, which means the sampling technique was intentional, including: project managers, site engineers, and schedulers responsible for activities on the critical path. The selected project details are presented in Table 1.

**Table 1.** Project Development SUTT 150 kV Kolaka–Pomalaa Switching – PT Antam Pomalaa Customer

Information	Detail
Project Owner	PT PLN (Persero) Sulawesi Development Main Unit Directorate of Work
Work	PT PLN (Persero) Southeast Sulawesi Project Implementation Unit
Supervising Consultant	PT PLN (Persero) Project Management Center
Implementing Contractor	PT Customer Antam Pomalaa
Project Location	Kolaka Regency, Southeast Sulawesi Province
Initial Contract Value	Rp. 83,538,758,235,- (including 11% VAT)
Effective Date	February 28, 2024
Contract Duration	300 Calendar Days from effective date to first stage handover (ST 1)
Milestone – 1	Energize Line GSW on October 24, 2024
Milestone – 2	Energize Line OPGW on November 30, 2024

The sampling technique used in this research is purposive sampling because it was chosen based on the consideration that only critical path activities with potential for duration reduction would be analyzed. Secondary sources are indirect sources in the form of available project document records related to the study, such as: project master schedule, contract book, daily progress reports, field notes, and S-curve charts [12] [13]. Data collection techniques to explore and answer the problem formulation used in this study were observation, interviews with project staff, and documentation review [14].

## 3. Results and Discussions

### 3.1. Results

Based on the work progress report document in July 2024 in the M19 week (July 06 – July 12, 2024) and *the S-Curve* according to Attachment 1, there is a deviation of -3.3899% (Negative Three Point Three Eight Nine Nine Percent) so that according to **Table 2.** the total volume is obtained before *crashing is applied* and the total volume to which *crashing will be applied* , with the following work details:

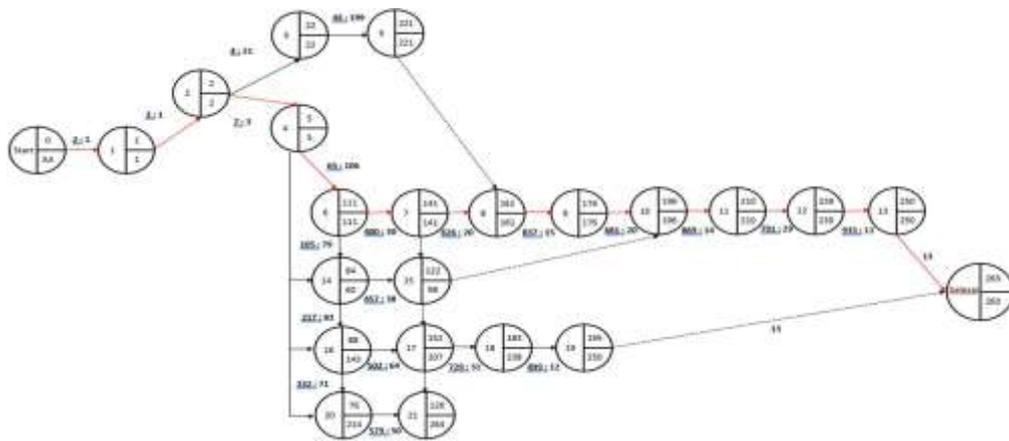
**Table 2.** Volume Work On Implementation Method *Crashing*

No	Item Work	Unit	BOQ Volume	Volume Before Crashing	Volume During Crashing
A. Installation Civil					
1	Foundation Works (all tower types)	Sets	56	10	46
2	Special Foundations (Drillpile &	Sets	12	0	12

	Special)				
3	Erection Works (all tower types)	Sets	51	13	38
<b>B. Electromechanical Installation / Stringing</b>					
4	Conductors Twin ACSR/AS 250	kmr	4.70	0	4.70
5	Conductors Twin ACSR/AS 450	kmr	13.80	0	13.80
6	GSW/AS 75	kmr	18.50	0	18.50
7	OPGW 75	kmr	18.50	0	18.50

Source: Processed from Contract Book, Project Master Schedule, and S-Curve Reports

Thus, strategic steps are needed to catch up on the delays in work in the field. Furthermore, to control the negative deviation, control is carried out using the *crashing method* through the help of computational analysis using MS Project 2007. The purpose of this *crashing* is to find the critical path marked with a red *bar chart* to the work items that can be started simultaneously without causing obstacles to the completion of other work [31]. The work contained in this critical path is a very crucial work item and must not experience work delays [32]. Control of work on this critical path also has the aim of determining the minimum duration in completing the project as a whole [33].



Picture 3 . Diagram Net Work

Based on the network diagram shown in Figure 3 and the results of schedule analysis using MS Project 2007 (Appendix 1), the critical path for the SUTT 150 kV Kolaka–Pomalaa Switching – PT Antam Pomalaa Customer project was identified. The critical path begins with the Kick Off Meeting (ID: 2) and the Effective Date (ID: 3), followed by Delivery of Stubs for TIP 41–54 (ID: 7). Subsequent activities include Foundation Works Priority 01 for TIP 40–54 with 2 × ACSR 250 (ID: 65), Erection Works Priority 01 for the same segment (ID: 400), and Stringing Works for both OPGW (ID: 626) and GSW (ID: 837) lines within TIP 40–54. The critical path continues with Stringing OPGW Priority 02 (ID: 681) and Stringing GSW Priority 02 (ID: 869) for TIP 01–11, as well as Stringing OPGW Priority 04 (ID: 791) and Stringing GSW Priority 04 (ID: 933) for TIP 11–23.

The application of the crashing method directly influenced key field operations, particularly in foundation work, tower erection, and stringing activities. To optimize implementation, the project area was divided into four priority sections. Priority 1 (TIP 40–54) covers 15 tower points, Priority 2 (TIP 01–11) covers 11 towers, Priority 3 (TIP 23–40) covers 17 towers, and Priority 4 (TIP 11–23) covers 12 towers. This segmentation strategy aimed to spread potential risks, enabling more targeted monitoring and control of work progress in each zone. Following the segmentation, additional manpower was allocated to critical activities to accelerate progress. The changes in manpower requirements are presented in Table 3.

**Table 3. Manpower Changes After Crashing**

No	Work Team Category	Teams Before Crashing	Teams After Crashing	Additional Teams
1	Foundation Works	16	16	0
2	Tower Erection	9	9	0
3	Stringing Works	1	2	1
4	Erection Finishing	0	2	2
5	Stringing Finishing	0	2	2
6	Material Delivery	0	2	2
7	Material Sorting (Warehouse)	0	1	1
Total		26	34	8

Table 4 presents the comparison of tool and equipment availability before and after the implementation of the crashing method. The data show a significant increase in several categories to support accelerated work on critical path activities. Notably, the number of press and jacking tools increased from 6 to 14 units, and pulleys more than doubled from 240 to 480 units to facilitate faster stringing operations. Similarly, the provision of slings, vehicles, and specialized connectors was increased to reduce bottlenecks in field activities. These adjustments highlight the critical role of equipment readiness in achieving the targeted schedule reduction.

**Table 4. Tool Requirements After Crashing**

No	Tool Category	Units Before Crashing	Units After Crashing	Additional Units
1	Stringing Machines	1	2	1
2	Press & Jacking Tools	6 (2 press + 4 drum jack)	14 (6 press + 8 drum jack)	8 (4 press + 4 drum jack)
3	Slings (All Sizes)	9	18	9
4	Vehicles (Dump Trucks)	2	4	2
5	Connectors & Pulling Tools	14 (double swivel, sustrun tirfor)	28	14
6	Pulleys (Single/Triple Roll)	240	480	240

Table 5 presents a detailed breakdown of additional manpower and equipment costs resulting from the implementation of the crashing method. On the manpower side, the highest expenditure was allocated to material delivery teams at Rp 312,000,000, followed by stringing finishing teams at Rp 255,080,000, and stringing work teams at Rp 223,195,000. These figures reflect the high labor demand for sequential and finishing works, where timely execution is critical to avoid cascading delays along the critical path. The total additional manpower cost reached Rp 927,275,000, underscoring the substantial human resource investment required for acceleration.

On the equipment side, the most significant cost was the procurement of additional pulleys, totaling Rp 825,600,000, which was essential to expedite stringing operations. This was followed by the addition of dump trucks (Rp 100,000,000), stringing machines (Rp 50,000,000), and various pressing and jacking tools. Other items, such as slings and connectors, were also increased to ensure uninterrupted field activities. The total additional equipment cost amounted to Rp 1,027,650,640, bringing the combined additional expenditure to Rp 1,954,925,640. This highlights that while resource intensification successfully supports schedule recovery, it comes with a significant financial implication.

**Table 5. Consolidated Crashing Cost Summary**

Category	Detail Description	Additional Units / Teams	Cost per Unit	Total Cost (Rp)
Manpower	Stringing Work Team	1 team	35,000,000 / kmr	223,195,000
	Erection Finishing Team	2 teams	1,500,000 / tower	117,000,000
	Stringing Finishing Team	2 teams	20,000,000 / kmr	255,080,000
	Material Delivery Team	2 teams	4,000,000 / tower	312,000,000
	Material Sorting Team	1 team	20,000,000 / lump sum	20,000,000
<b>Total Manpower Cost</b>				<b>927,275,000</b>
Tools / Equipment	Stringing Machine	1 set	50,000,000 / month	50,000,000
	Machine Press	4 sets	80,000 / day	13,760,000
	Drum Jack	4 units	25,000 / day	4,300,000
	Slings (All Sizes)	9 haspel	35,000–45,000 / day	15,480,000
	Dump Truck	2 units	25,000,000 / month	100,000,000
	Connectors & Pulling Tools	14 pcs	15,000–80,000 / day	39,130,000
	Pulleys (Single & Triple Roll)	240 units	80,000 / day	825,600,000
	<b>Total Tool Cost</b>			
<b>Grand Total Crashing Cost</b>				<b>1,954,925,640</b>

Source: Processed from Project Financial Records

Table 6 summarizes the financial impact of the crashing method on the project’s overall contract value. The table shows that the base BOQ items remained unchanged, and the only cost increases came from additional manpower and equipment, amounting to Rp 927,275,000 and Rp 1,048,270,000 respectively. These two components contributed to a total additional cost of Rp 1,975,545,000, which raised the total contract value from Rp 75,260,142,554 to Rp 77,235,687,554. This demonstrates that while the crashing method effectively shortened the project duration, it did so with a measurable increase in project expenditure.

**Table 6 BOQ Impact and Contract Value After Crashing Implementation**

No	Description	Before Crashing (Rp)	After Crashing (Rp)	Change (Rp)
1	Additional Manpower Costs		927,275,000	+927,275,000
2	Additional Tool / Equipment Costs		1,048,270,000	+1,048,270,000
<b>Total Additional Costs Due to Crashing</b>			<b>1,975,545,000</b>	<b>+1,975,545,000</b>
<b>Total Contract Value</b>		<b>75,260,142,554</b>	<b>77,235,687,554</b>	<b>+1,975,545,000</b>

The application of the crashing method in the SUTT 150 kV Kolaka, Pomalaa project shows that targeted increases in manpower and equipment on critical path activities can effectively recover delays. Consistent with Anggraeni and Poerba, the most significant gains came from adding resources to sequential works such as stringing and finishing, supported by equipment upgrades to avoid bottlenecks [7] [8]. While this approach raised costs by Rp 1.98 billion (2.62% of contract value), similar to findings by Adi, the expense is justified by the avoidance of penalties and the earlier commissioning of the smelter’s power supply, reflecting the strategic value of timely completion in critical infrastructure [9].

**4. Conclusion and Suggestion**

**4.1 Conclusion**

The application of the crashing method in the 150 kV Kolaka- Pomalaa Switching - PT Antam Pomalaa Customer project successfully reduced the planned construction duration from 300 to 263 calendar days, representing an acceleration of 37 days. This time reduction was achieved through targeted allocation of additional manpower and tools on critical path activities, particularly in foundation, erection, and stringing works. The acceleration resulted in an additional manpower cost of Rp 927,275,000 and an additional tools/equipment cost of

Rp 1,027,650,640, bringing the total additional expenditure to Rp 1,975,545,000. Despite the cost increase, the method effectively optimized resource utilization to meet the revised completion target.

#### 4.2 Recommendations

Future projects implementing the crashing method should ensure strict progress monitoring to maintain adherence to the revised schedule and to minimize unforeseen delays. An up-to-date inventory of available tools and equipment should be maintained to allow for rapid mobilization when acceleration measures are required. Further studies could explore combining crashing with other project control techniques to achieve cost–time optimization with reduced financial impact.

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