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RISK ANALYSIS ON THE CONSTRUCTION PROJECT OF THE 150 KV BANGKALAN HIGH VOLTAGE TRANSMISSION NETWORK

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Abstract

Electricity project implemented by PT. PLN (Persero) UIP JBTB is a construction project of the High Voltage Transmission Network and High Voltage Cable Channel 150 kV Bangkalan. The construction will certainly stretch across various terrains that have various levels of risk in the construction process. In addition, the construction project of the High Voltage Transmission Network and High Voltage Cable Channel 150 kV is a very complex project so that each stage has different obstacles so that it has the potential to have high risks in its implementation. The risk management will be based on SNI 8615:2018 ISO 31000:2018 regarding Risk Management – Guidelines and SNI IEC/ISO 31010:2016 Risk Management – Risk Assessment Techniques. The risk management process begins with determining the scope, context and risk criteria and then proceeds with the risk assessment process which includes identification, analysis, risk evaluation and risk treatment. This research was conducted to identify the risks that arise in the High Voltage Transmission Network and High Voltage Cable Channel 150 kV Bangkalan transmission development project and formulate the most effective response for each extreme, very high and high risk category of the project. The risk analysis of the Transmission Network project was carried out using a qualitative method to obtain a risk category. At risk that have extreme, very high, and high categories are risks that cannot be tolerated and a quantitative analysis will be carried out using the Expected Monetary Value method as measured data. Furthermore, with the Decision Tree Analysis diagram, several alternative risk treatment branches will be obtained which will then be analyzed using the multiplication of the response success value with the cost impact value in order to obtain the most effective treatment option. The results of the risk treatment will be categorized into risk mitigation, transferring risk, and accepting risk and the result of residual risk will be known through testing the effectiveness of handling risk treatment. The highest risk in this study is the risk of less than optimal contractor performance which causes project completion to be late with risk treatment by means of the good/services provider process being selected through an auction process which is included in the list of selected providers. The recording the risk register is also carried out as a database in risk analysis research on the construction project of the 150 kV Bangkalan high voltage transmission network.

Keywords: Decision Tree Analysis, Expected Monetary Value, Risk Treatment, Residual Risk, Risk Register

INTRODUCTION

PT. PLN (Persero) as a State-Owned Enterprise in the electricity sector carries out a mandate from the Government to maintain the continuity of development and efficient operation of the electricity sector as a stimulus for economic growth (Hanan & Fuady,

2023). One of the units of PT. PLN (Persero) which plays a role in the construction of electricity installation projects in East Java and Bali is PT. PLN (Persero) UIP JBTB (Unit Induk Pembangunan Jawa Bagian Timur dan Bali). One of the electricity projects implemented by PT. PLN (Persero) UIP JBTB is a transmission network development project for High Voltage Air Line and High Voltage Cable Channel (Suprihastini, 2020). The High Voltage Transmission Network 150 kV Bangkalan is one of the electricity infrastructure developments that requires risk analysis in project control. The application of risk analysis is used to formulate an appropriate and appropriate risk control model, by applying it to the Transmission Network construction project, so that the project can be completed with the planned target (Monroe & Asy'ari, 2021). The challenge in the construction of the High Voltage Transmission Network 150 kV Bangkalan is the electricity demand on Madura Island which needs to be supplied from Surabaya through the High Voltage Cable Channel 150 kV Suramadu circuits 1 and 2 with a maximum capacity of 284 MW where the peak load has reached 273 MW which has served 926,707 customers, where 71% of that amount are subsidized customers. If there is a disturbance or maintenance on one of the circuits, there will be blackouts in parts of Madura Island (Nurdin, 2019). In order to improve the reliability of electricity supply on Madura Island and to avoid blackouts, PLN has built a 150 kV Kedinding – Tx Bangkalan High Voltage Cable Channel circuit 3 and 4 and built a 150 kV Bangkalan Incomer High Voltage Air Line which is a National Strategic Project (PSN), as stated in the General Plan of Electric Power Providers. (RUPTL) PLN 2021-2030 which has been ratified through the Decree of the Minister of Energy and Mineral Resources of the Republic of Indonesia Number 188.K/HK.02/MEM.L/2021 concerning the Ratification of the Business Plan for the Provision of Electric Power (RUPTL) 2021-2030 with an operating target year 2023.

150 kV High Voltage Bangkalan Transmission Network which are constructed will certainly stretch through various kinds of terrain such as settlements, straits, rice fields, roads and so on, each of which has various risks in its construction. Because the research location is on a construction project that crosses the Suramadu Bridge, the construction process will also have a high risk from both the management side of the Suramadu Bridge and road users on the Suramadu Bridge (Ongkowijoyo, Gurmu, & Andi, 2021). This is in accordance with research findings by Indraswari, (Miller & Waller, 2003) which states that project development has various potential risks from various aspects that must be anticipated. Risk control in the 150 kV Bangkalan High Voltage Transmission Network project is an integral part of management's responsibility, in ensuring the achievement of project development goals and organizational goals (Monroe & Asy'ari, 2021). In the construction of the 150 kV Bangkalan High Voltage Transmission Network project, it is also necessary to know the risks that arise due to organizational & management factors related to the reporting of work progress, the risks that arise due to financial & economic factors related to inflation resulting in an increase in material prices, unexpected costs in the form of extortion or donations imposed by the community around the project, risks that arise

due to cultural & environmental factors related to conflicts between villages, land disputes, risks that arise due to design aspects, work location, physical conditions of work and risks that arise due to condition factors natural disasters related to weather conditions such as rain for a long time or natural disasters that can cause work to be hampered. All of these aspects become the main focus that influences each other how the cost impact of the 150 kV Bangkalan High Voltage Transmission Network project is interconnected and risks hampering project completion. Thus, it is very necessary to identify good risks to find out all the risks that must be faced at the project development stage (Monroe & Asy'ari, 2021). The implementation of project risk management is a very important thing owned by the company, because the risks that occur can be managed and minimized to achieve company goals (Maharani, 2018). By using risk management, it will be known the risks that may occur and have an impact on project work, these risks can finally be anticipated and eliminated for the next project. Making risk management will be based on SNI 8615:2018 ISO 31000:2018 regarding Risk Management – Principles and Guidelines. SNI 8615:2018 ISO 31000:2018 describes the components of a risk management framework that includes important steps in the implementation and ongoing support of the risk management process (AIRMIC, 2010). So that by using SNI 8615:2018 ISO 31000:2018 as an umbrella to make risk management this will make it easier to manufacture and work. In addition, ISO 31000 is an international standard that has been recognized by the world (Dumara, 2017). Based on the potential risk events that exist, of course PT PLN must also prepare response steps that must be taken so that these potential risks do not develop into an event that actually occurs. This anticipation is a form of risk treatment to the potential risks that occur in the construction of the 150 kV Bangkalan High Voltage Transmission Network. With this risk treatment, the control of a risk event will be better without any events that harm all related parties (Wideman, 2022). Determining the treatment to potential risks in a project is an important thing that should not be overlooked. Based on research, there are four types of treatments to risks that may occur during project implementation, namely avoiding risk, transferring risk, mitigation/reducing risk, and accepting risk (Sukaarta, Sompie, & Tarore, 2012). Based on the description of the background above, it is very important to conduct research on "Risk Analysis in the Construction of the 150 kV Bangkalan High Voltage Transmission Network Project". Various risks that may arise in the project will be reviewed from the point of view of the project owner in terms of organizational and management aspects, identified using a literature study that is strengthened by the results of Focus Group Discussions with expert judgment and related parties, which is then analyzed qualitatively with a risk matrix and quantitatively with the Expected Monetary Value & Decision Tree Analysis method until the most effective treatment is obtained to address each high, very high and extreme risk category that may arise in the construction project of the transmission network 150 kV Bangkalan by PT. PLN (Persero).

METHODS

This research methodology describes the steps that will be carried out in the research, including the mechanism of data collection and the types of methods used for data analysis

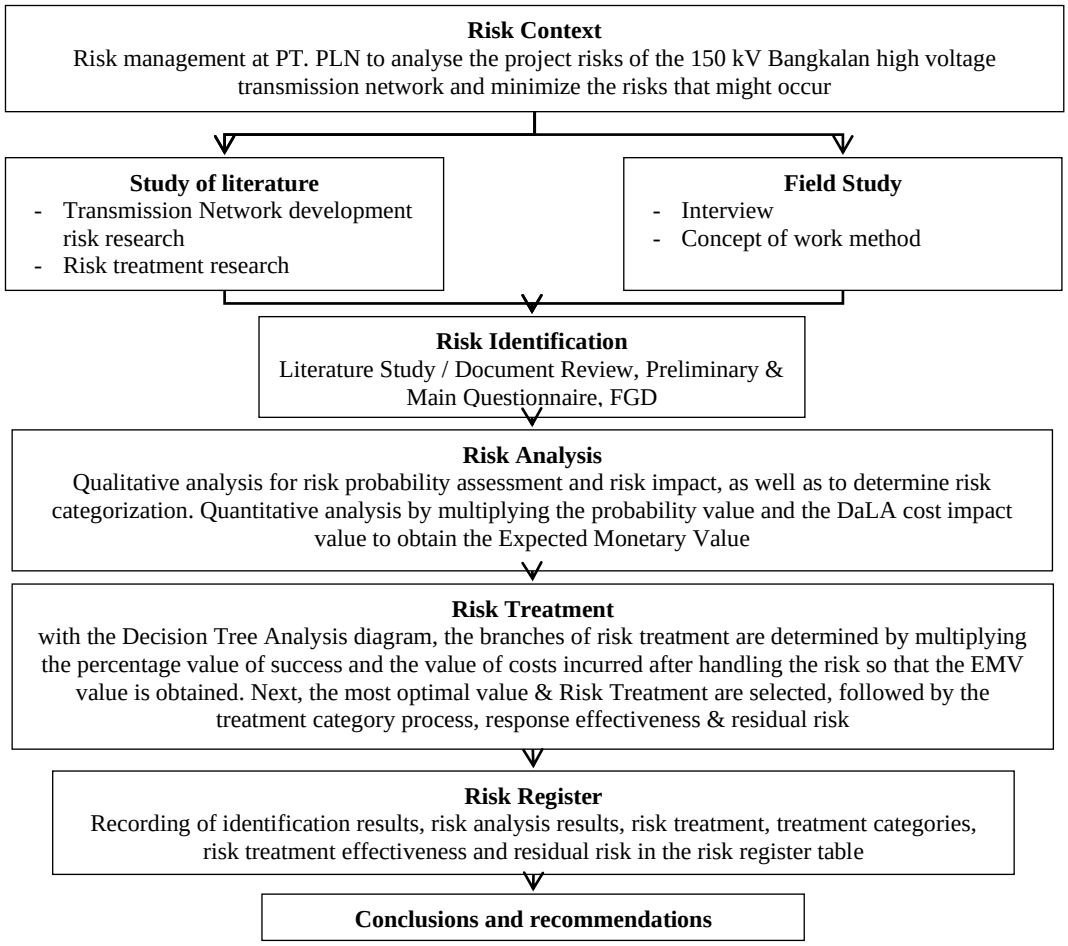

Figure 3. Research Flow

The research "Risk Management in the Construction of the 150 kV Bangkalan High Voltage Transmission Network Project" is a type of case study research which is descriptive qualitative research. Case study research is intended to study the background of the problem, the situation and position of an event, as well as the interaction of certain objects that are given as they are.

The variables in this study were obtained from literature studies and field studies with expert judgment interviews of construction involved in the construction of the Transmission Network project seen also from the perspective of the project owner, namely PT PLN (Persero). The variable is a list of risk identification that may occur during the construction of the 150 kV High Voltage Transmission Network in Bangkalan. Especially the risk identification that will be discussed are the stages during the construction of the 150 kV Bangkalan High Voltage Transmission Network project. According to Giri, the determination of risk sources during the implementation of relevant projects is based on the categories of Organizational & Managerial, Finance &

Economics, Culture & Environment, Job Design, Work Location, Physical Work, and Natural Conditions (Monroe & Asy'ari, 2021). The research variables in order to identify occupational risks in each category and job risk event.

Table 4. Research Variables to Identify Risks in the 150 kV Bangkalan Transmission Network Project

No.	Risk Identification
1	**Organizational, Managerial and Human Resources Aspects**
	Inaccurate reporting of work progress for supervision
	Project execution time is not in accordance with the project schedule
	Lack/no competence of field implementers
	Lack/no competence of field supervisors
	At least holding coordination meetings in the field
	Weak service provider administration and documentation system
	Low evaluation and decision-making system
	Delay in the approval of the bridge manager to start the work
	The tender for the Bangkalan SKTT-SUTT 150 kV development project was late & failed
	Delay in document approval
	Less than optimal contractor performance causes project completion to be delayed
	The commissioning process (voltage-worthy recommendation) is late
	The process of issuing a certificate of proper operation is late
	Delay in project handover
2	**Financial and Economic Aspects**
	Error in calculating unit price and unit price of work
	Project funding was hampered due to delays in down payments/terms
	Unexpected costs in the form of extortion or donations imposed by the community around the project
	Changes in the country's economic conditions and government policies on finance
	Project investment costs that exceed the budget ceiling
	The operational and maintenance costs of the Bangkalan SKTT-SUTT are very high
	Investment Budget Decision Letter that has not yet been issued
3	**Cultural and Environmental Aspects**
	There are issues by NGOs to local communities regarding the dangers of transmission lines
	The payment of compensation for land/plants passed by the transmission line has not yet been completed
	Temporary cessation of work due to national holidays, traditional ceremonies, religious ceremonies
	Work stops orders by local government authorities
	Conflicts between regions traversed by transmission lines
	Permits from local government authorities to carry out work have not been issued/constrained
	The existence of irresponsible elements who interfere with project implementation

No.	Risk Identification
	(extortion, etc.)
	Slow land acquisition and compensation process
	There are residents' resistance to land acquisition
	Land acquisition process in conflict with other agencies (PT KAI, PUPR, and local government)
	Community protests on development that does not involve citizens
	Changes in ownership of land, buildings and plants crossed by the ROW route
	The process of implementing the project disrupts the flow of traffic
	There is a land dispute in the process of land acquisition
	Community rejection of the results of determining the location of the SUTT-SKTT
4	**Design Aspects and Work Documents**
	Working drawings (shop drawings) have not been approved by the owner of the job
	Tower design changes
	Design error
	The technical specifications required does not match the conditions in the field
	The data used in the feasibility study is less accurate, so it has the potential to cause estimation errors
	Improper planning that has the potential to pose a risk of changes to the plans that have been made
	Incomplete BOQ details
	Late completion of tower data survey survey
	Error calculation and processing of survey data
	Survey results for determining the location of the SUTT tower and SKTT cable are inaccurate
5	**Aspects of Job Location**
	Unavailability of access for materials, equipment and work to the site
	Unavailability of resources for civil works and working water on site
	Unavailability of power source on site to perform certain work
	Lack of communication tools for coordination and supervision
	The condition of the soil structure at each location requires different methods and times of foundation work
	The low productivity of local labor is not as expected
	Work accidents for work at height
	Security conditions at the project site that may pose a risk of loss of project materials or logistics
	The occurrence of traffic jams around the project site due to the construction of the project
	Difficulty in sliding materials (locations that are difficult to reach and far from major roads)
6	**Physical Aspects of Work**
	Damage to equipment during use at locations that take a long time to repair
	Incomplete material in the field for tower structure and stringing works

No.	Risk Identification
	Theft/loss of tower structure materials
	Inadequate technical personnel for certain jobs that require expertise
	Material discrepancy in the field with the specifications required
	There is a defect in the work so that it does not match the specifications and technical requirements
	Uncertainty in the availability of materials needed for construction creates the risk of increasing costs
	Errors in applying standard construction methods to do a job
	Error applying fieldwork drawing
	Waste of material usage on site
	Errors in applying standard construction methods to do a job
	Lack of equipment to support work in the field
	The need for adequate technology for very complex jobs
	The implementation of the project caused security disturbances to the condition of the Suramadu bridge
	There was a fire / spark on the cable and bridge due to construction errors
	The reliability of the Bangkalan SKTT-SUTT 150 kV electrical system has been compromised
	Delay in arrival of materials
	Construction errors caused the tower to collapse
	Environmental pollution due to work
	Damage to buildings around the construction work area
7	**Aspects of Natural Conditions**
	Weather conditions such as rain, wind, and so on for a long-time cause work to be hampered
	The existence of natural disasters such as earthquakes, landslides, floods, volcanic eruptions cause work to stop

The project risks that have been identified are then analyzed qualitatively, namely based on data obtained from FGDs with research respondents to obtain an assessment of risk in order to obtain information needed for further analysis. Risk identification is analyzed by qualitative method by plotting the level of likelihood against the level of impact in the Risk Matrix table, where the identification / variable is determined based on the level of likelihood and level of impact. The 150 kV Bangkalan High Voltage Transmission Network Project is in accordance with Table 5 which is used as the basis for assessing the possibility of risk and filling out the impact scale according to Table 6.

Table 5. Level of Likelihood in the 150 kV Bangkalan High Voltage Transmission Network Project

Risk Parameter Level of Likelihood	Probability	Qualitative Description	Previous Incident

1	**Almost Certain**	> 80% - 100%	Almost certainly will happen	Happened more than once in the last 6 months
2	**Likely**	> 60% - 80%	Most likely will happen	Happened once in the last 6 months
3	**Possible**	> 40% - 60%	The probability is the same between it will happen and not happen	Happened once in the last 1 year
4	**Unlikely**	> 20% - 40%	It's less likely to happen	Did not happen within the last 1 year
5	**Rare**	0% - 20%	Almost certainly won't happen	Never happened in a span of more than 1 year

Table 6. Level of Impact in the 150 kV Bangkalan High Voltage Transmission Network Project

Factor	**Impact Scale**				
	Insignificant	**Minor**	**Moderate**	**Major**	**Catastrophic**
Cost	Almost no increase in project costs (Fee increase 0.1%)	The increase in project costs is not significant (0.1% Cost increase 0.5%)	The increase in project costs is quite significant (0.5% < Cost increase 1%)	Significant increase in project costs (1% < Cost increase 2%)	The increase in project costs is very significant (2% < Cost increase)
Scale	1	2	3	4	5

From the Qualitative Analysis using the Risk Matrix, namely the comparison between the level of likelihood and the level of impact, there are five different colors in the matrix in Table 3. The qualitative analysis process is shown in Table 7.

Table 7. Risk Categories in the Comparison of Likelihood Levels x Impact Levels

No.	**Risk Identification**	**Likelihood Level**	**Impact Level**	**Category Box**	**Information**
…	Risk variables	Filling the level of possible risk based on the results of the FGD.	Filling in the level of risk impact based on the results of the FGD.	Risk categories based on risk matrix plotting	Extreme Risk Very High Risk High Risk Moderate

No.	Risk Identification	Likelihood Level	Impact Level	Category Box	Information
					Risk
					Low Risk

Risks with Extreme, Very High, and High levels are types of unacceptable risk in the 150 kV Bangkalan High Voltage Transmission Network project and must be responded to (Xu, Chen, Cheng, & Lo, 2014). These risks must be analyzed further in order to obtain solutions in the form of appropriate treatments to handle extreme, very high, and high risks. Quantitative analysis was carried out to obtain measurable data to determine the impact on costs using Expected Monetary Value (EMV) and Decision Tree Analysis. The use of these two instruments in risk analysis has been conducted by researchers where EMV is used to determine the costs that must be incurred for each treatment alternative, while Decision Tree Analysis is used to choose the best treatment among several alternative responses (Taroun, Yang, & Lowe, 2011). The data taken is the percentage of the effect of the response effort and how much the response effort costs. The decision-making process with decision tree analysis and EMV calculation diagrams is shown in Figure 4

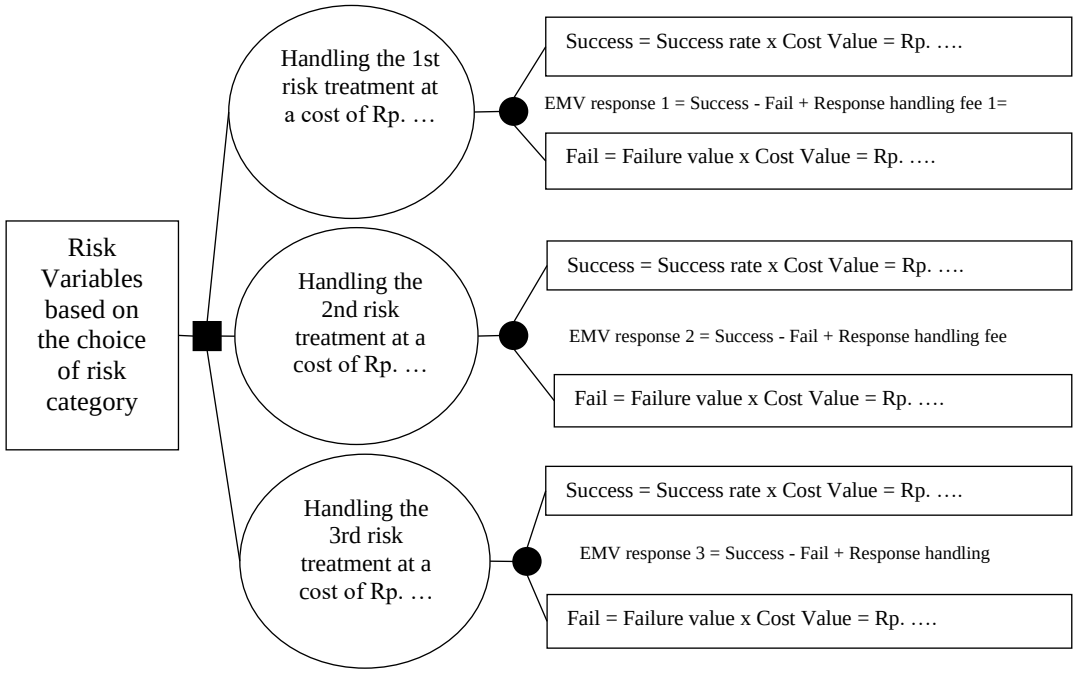

Figure 4. Calculation Diagram with Decision Tree Analysis and EMV

Based on the results of the Decision Tree Analysis, the treatment that can provide the greatest benefit from the alternative branch is the treatment that has the lowest EMV value after the treatment compared to other alternatives and the previous EMV. The next step after selecting treatment alternatives is to categorize the treatment. The risk treatment of each decision choice will be categorized into mitigation/reducing risk, transferring risk, and accepting risk. This act of accepting risk is usually applied to risks with a low and moderate level of risk for the company so that if the residual risk is

handled, it will cause costs that are not proportional to the company's profits. After the risk treatment and treatment effectiveness test have been carried out, the residual risk calculation is then carried out which is used to determine the residual risk value after the treatment. The residual risk from the risk treatment results based on the DTA diagram and EMV calculation will be reviewed based on the value of the cost impact that must be included in the moderate and low-level risk categories in accordance with the basis for determining risk appetite limits and risk tolerance. If at the residual risk stage there is still risk with extreme, very high, or high levels, then the risk treatment process needs to be carried out further until the risk target is achieved in accordance with the risk tolerance.

After the risks are identified, analyzed, responded to and the residual risk results are obtained, the entire risk management process will be recorded in the Risk Register of Risk Management in the Construction of the 150 kV Bangkalan High Voltage Transmission Network Project. Risk Register is a document or database containing a list of identified risks along with the results of their analysis and handling related to activities.

RESULTS

From the results of risk identification, we assess the level of likelihood and level of impact with FGDs. After that, the 10 highest risk categories were obtained and can see in Table 8.

Table 8. Risk Variables with High, Very High and Extreme Risk Categories

No.	Risk Identification	Likelihood Level	Impact Level	Category Box	Information
1	Delay in the bridge manager's approval to start the work	D	4	D.4	Very High Risk
2	The contractor's performance is less than optimal causing late project completion	C	3	C.3	High Risk
3	Project handover delay	C	3	C.3	High Risk
4	The payment of compensation for land/plants passed by the transmission line (ROW) has not yet been completed	D	4	D.4	Very High Risk
5	Changes in ownership of land, buildings and plants crossed by the ROW	C	3	C.3	High Risk
6	The project implementation process disrupts traffic flow	C	3	C.3	High Risk
7	The implementation of the project causes a security disturbance in the condition of the Suramadu bridge	C	4	C.4	High Risk
8	There was a fire / sparks on the cables and bridges due to construction errors	B	5	B.5	Very High Risk
9	The reliability of the 150 kV Bangkalan Transmission Network electricity system is disrupted	B	5	B.5	Very High Risk
10	Damage to buildings around the construction work area	A	4	A.4	High Risk

In the Extreme Risk category there are no risk variables, while 4 risks are in the Very High-Risk category, and 6 risks are in the High Risk category. Furthermore, these 10 risks need to be followed up with Quantitative Analysis using the Expected Monetary Value (EMV) and Decision Tree Analysis (DTA) methods.

Table 9. EMV Values for High, Very High and Extreme Risk Categories

No.	High and Very High-Risk Variables	Probability Value	Impact Value (Rp)	EMV = Probability Value x Impact Value
1	Delay in the bridge manager's approval to start the work	0,8	2.478.000.000,00	1.982.400.000,00
2	The contractor's performance is less than optimal causing late project completion	0,6	3.477.313.365,78	2.086.388.019,47
3	Project handover delay	0,6	2.781.850.692,62	1.669.110.415,57
4	The payment of compensation for land/plants passed by the transmission line (ROW) has not yet been completed	0,8	2.262.386.981,00	1.809.909.584,80

No.	High and Very High-Risk Variables	Probability Value	Impact Value (Rp)	EMV = Probability Value x Impact Value
5	There are irresponsible persons who interfere with project implementation	0,8	530.448.000,00	424.358.400,00
6	Changes in ownership of land, buildings and plants crossed by the ROW	0,6	530.448.000,00	318.268.800,00
7	The project implementation process disrupts traffic flow	0,6	250.629.941.45	150.377.964,87
8	Occupational accidents for work at height	0,2	242.753.487,81	48.550.697,56
9	The implementation of the project causes a security disturbance in the condition of the Suramadu bridge	0,6	375.944.912.18	225.566.947,31
10	The reliability of the 150 kV Bangkalan Transmission Network electricity system is disrupted	0,4	1.563.879.000,00	625.551.600,00

With the Decision Tree Analysis diagram, the branches of risk treatment are determined by multiplying the percentage value of success and the value of costs incurred after handling the risk so that the EMV value is obtained. In Table 10, we can see the risk treatment, most optimal value calculates with EMV using DTA and selected treatment and the residual risk.

Table 10. Risk Treatment for High, Very High and Extreme Risk Categories

No.	High and Very High-Risk Variables	Risk Treatment	EMV Calculation with DTA Diagram	Selected Treatment	Residual Risk
1	Delay in the bridge manager's approval to start the work	1. Coordinate with Bridge managers regarding the manufacture of Detail Engineering Designs and cooperate with independent consultants for DED approval and re-design in accordance with Bridge Manager specifications and requirements	1.098.187.500	1	Moderate Risk
		2. Improvement design of existing cables with monitoring, protection, security, operation and maintenance systems as well as fire prevention systems.	1.939.522.500		
2	The contractor's performance is less than optimal causing late project completion	1. The process of providing goods/services is selected through an auction process that is included in the List of Selected Providers, contractors who carry out construction development are not included in the blacklist and emphasis is placed on the substance of the agreement which contains rights & obligations between the two parties where there is an administrative sanction clause (fines) if the contractor does not complete the project on time	517.277.603,90	1	Moderate Risk
		2. Accelerate payment of work progress to maintain contractor cashflow, monitor contractor work and performance on a regular basis and contractors with less-than-optimal performance will be given a warning letter, fined and put on the blacklist	1.301.832.811,68		
		3. Evaluating 5M (Man, Material, Machine, Method, Money) in regular meetings, instructing to add competent workforce, adding and using adequate work materials/tools.	864.555.207,79		
3	Project handover delay	1. Accelerate the completion of pending construction work items, speed up the land certification process and monitor the completion of requirements for Project Handover	867.644.166,22	1	Moderate Risk
		2. Conduct a coordination meeting with the Project Handover Team, namely the development unit and the operational unit	1.101.466.249,33		
4	The payment of compensation for land/plants passed by the transmission line (ROW) has not yet been completed	1. Monitoring the progress of land acquisition and compensation for ROW and looking for the root cause of the non-payment of payments. After knowing the problem, then an approach is carried out with the residents and relevant stakeholders through a further socialization process by involving experts from public consultants, TP4D, local governments, religious leaders/community leaders and assistance with the Office of Public Appraisal Services in the context of assessing compensation/compensation, as well as providing compensation. Corporate Social Responsibility (CSR) assistance in carrying out social and environmental responsibilities around project development.	1.123.963.833,56	1	Moderate Risk
		2. Land compensation and ROW compensation are entrusted to the district court / consigned	1.547.927.667,84		
5	There are irresponsible persons who interfere with project implementation	1. Coordination with stakeholders including local government, religious leaders/community leaders, looking for the root cause of the person who is interfering with the project, then approaching the residents and relevant stakeholders through an advanced socialization process	304,615,040,00	1	Low Risk
		2. Providing Corporate Social Responsibility (CSR) assistance in order to carry out social and environmental responsibility around project development.	439.486.720,00		

No.	High and Very High-Risk Variables	Risk Treatment	EMV Calculation with DTA Diagram	Selected Treatment	Residual Risk
6	Changes in ownership of land, buildings and plants crossed by the ROW	1. Coordinate with the village government, and local residents as well as landowners to find out the boundaries & actual owners of land, buildings, and perennials crossed by the ROW route, re-check surveys accurately involving residents and accompanied by village officials and complete administrative documents completely and thoroughly	220.961.280	2	Low Risk
		2. The results of the inventory survey are socialized to all residents related to the project, residents who own land, buildings, and perennials, witnessed by stakeholders (village government, KJPP) and signed for mutual agreement in the Minutes of Submission of Inventory Results so that there is no change of ownership back in the future	197.307.520		
		3. If there are doubts regarding the ownership of land, buildings, and perennials related to land compensation and ROW compensation, they are entrusted to the district court / consigned	163.653.760		
7	The project implementation process disrupts traffic flow	1. Develop SOPs for implementing the most effective work and causing as little traffic disruption as possible.	135.264.575,41	2	Low Risk
		2. Coordinate with the Traffic Police and other related parties for the preparation of traffic engineering arrangement scenarios during the work period	130.151.185,95		
8	Occupational accidents for work at height	1. Conduct K3 training for K3 management and PIC, carry out K3 socialization/education to work partners, implement requirements for K3 supervisors in projects that must be certified at least General AK3, make PPE control check lists, review SOP JSA IBPR construction work and carry out audits/sights/inspections K3 with partners.	19.420.279,03	1	Low Risk
		2. Implement the use of the Working Permit Online application which includes the Safety Briefing Online feature and realtime photo updates by K3 supervisors to prevent unsafe actions and unsafe conditions at each construction work site and use the Inspecta application to monitor unsafe actions and unsafe conditions in the project environment.	19.710.139,51		
		3. Carry out temporary work stoppages caused by work accidents, give written warnings to Partners/Contractors, and demand Partners to be responsible in the event of an accident	44.855.069,75		
9	The implementation of the project causes a security disturbance in the condition of the Suramadu bridge	4. Ensure the implementation of the utility deployment in accordance with the agreed SOP and ensure that the work implementation meets bridge construction standards and K3, traffic regulation and road user safety	95.113.389,46	1	Low Risk
		5. Supervise and report on the implementation of work periodically to the Bridge Manager, create a Joint Operation Committee between PLN and the Bridge Manager to ensure coordination and approval in each process.	205.340.168,39		
		6. Conducting mediation with the Bridge Manager regarding the problem of compensation for damage due to project implementation	190.226.778,92		
10	There was a fire / sparks on the cables and bridges due to construction errors	1. Using XLPE insulated cable (Heat Resistant up to 90°C) and vibration resistant Corrugated Alloy Sheath type with Partial Discharge Monitoring implementation, cable external protection with Cable Coating, electrical system protection using main and back up pattern protection, installation of fire extinguishers portable, hydrant installation, providing a PLN office near the Suramadu Bridge as a Control Room and Fire Fighting Unit, providing CCTV at the Main Bridge as well as conducting periodic inspections and maintenance of cable conditions, including surprise (CCTV, load current, temperature, visual), 3 months (thermovision), 6 months (maintenance in the manhole), 1 year (simulation of emergency conditions with stakeholders), providing trained human resources for monitoring the Health of the cable and human resources for the Fire Emergency Rapid Response Team (TRC)	95.113.389,46	1	Moderate Risk
		2. Performing Risk Transfer by insuring cable assets and file a cable insurance claim in case of interference.	2.130.441.280		
		3. Making SOPs (including Basic Communication and organizations related to handling in the event of a fire, periodic joint inspections between PLN and BBPJN and implementing the company's K2 and K3 programs strictly	425.330.960,00		

CONCLUSIONS

Based on the results that have been carried out in the previous chapter, conclusions can be drawn that answer the research problem formulation as follows: In the Bangkalan SUTT-SKTT 150 kV transmission network development project, based on a qualitative risk analysis method with a risk matrix, there are 5 risk categories,

namely: 42 risks in the low risk category, 26 moderate risks, 7 high risks, 3 very high risks and none extreme risk. In accordance with risk appetite criteria (risk acceptability/risk appetite) and risk tolerance criteria (risk tolerability/risk tolerance), then there are 10 risks that fall into the high and very high categories, including: • the risk of delaying the approval of the bridge manager to start carrying out the work, • risk of sub-optimal contractor performance causing project completion to be delayed, • risk of delay in project handover, • risk of incomplete payment of compensation for land/plants passed by the transmission line (ROW), • the risk of irresponsible persons interfering with project implementation, • risk of change in ownership of land, buildings and plants crossed by the ROW line, • the risk of the project implementation process disrupting traffic flow, • risk of work accidents for work at height, • the risk of project implementation causing security disturbances to the condition of the Suramadu bridge, and • risk of fire / sparks on cables and bridges due to faulty construction.

REFERENCES

Dumara, S. (2017). Analisis Risiko Berdasarkan Konsep Manajemen Risiko ISO 31000: 2009 Pada Proyek Floating Storage Offloading. Tesis.

Hanan, N. N., & Fuady, M. S. (2023). Review Of Electricity Subsidies In Indonesia 2015-2020. *Jurnal Pajak Dan Keuangan Negara (PKN)*, *4*(2), 529–538.

Hudyah, B. S. (2015). *Analisa Risiko Proyek Pembangunan Pembangkit Listrik Tenaga Sampah (PLTSA) di Palembang*. Surabaya: Institut Teknologi Sepuluh Nopember.

Maharani, A. R. (2018). Perancangan manajemen risiko operasional di PT. X dengan menggunakan metode house of risk. *Institut Teknologi Sepuluh Nopember Surabaya*.

Miller, K. D., & Waller, H. G. (2003). Scenarios, real options and integrated risk management. *Long Range Planning*, *36*(1), 93–107.

Monroe, G. T., & Asy'ari, M. (2021). KESALAHAN POSISI (DISPLACEMENT) DATA HASIL PENGUKURAN ALAT GPS GARMIN 78s TERHADAP DATA PENGUKURAN ALAT TOTAL STATION PADA TITIK-ITIK TOWER SUTT 150 KV AMUNTAI-TAMIANG LAYANG. *Jurnal Sylva Scienteae*, *4*(2), 285–290.

Nurdin, Y. (2019). Understanding the cascading failures in Indonesian power grids with complex network theory. In *2019 IEEE International Conference on Cybernetics and Computational Intelligence (CyberneticsCom)* (pp. 50–55). IEEE.

Ongkowijoyo, C. S., Gurmu, A., & Andi, A. (2021). Investigating risk of bridge construction project: Exploring Suramadu strait-crossing cable-stayed bridge in Indonesia. *International Journal of Disaster Resilience in the Built Environment*, *12*(1), 127–142.

Sukaarta, I. W., Sompie, B. F., & Tarore, H. (2012). Analisis Resiko Proyek Pembangunan Dermaga Study Kasus Dermaga Pehe Di Kecamatan Siau Barat Kabupaten Kepulauan Sitaro. *Jurnal Ilmiah Media Engineering*, *2*(4).

Suprihastini, T. (2020). Pengembangan Mutu Dosen Sekolah Tinggi Agama Islam At Taqwa Bondowoso Tahun Akademik 2019/2020. Institut Agama Islam Negeri Jember.

Taroun, A., Yang, J. B., & Lowe, D. (2011). Construction risk modelling and assessment: Insights from a literature review.

Wideman, R. M. (2022). *Project and program risk management a guide to managing project risks and opportunities*. Project Management Institute, Inc.

Xu, X., Chen, A., Cheng, L., & Lo, H. K. (2014). Modeling distribution tail in network

performance assessment: A mean-excess total travel time risk measure and analytical estimation method. *Transportation Research Part B: Methodological*, *66*, 32–49.