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Risk Management in Oil and Gas Field Development Project with Marginal Resources: A Case in Mature Field in East Kalimantan

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ABSTRACT

The oil and gas industry and risks are very related to each other. There are several risks known in this industry, from economic risks, political risks, environmental and safety risks, up to geological risks itself. Because oil and gas are a non-renewable source of energy, the more mature an oil and gas field is, the risks for the company to develop a project investment may be lower and higher at the same time. Entering its declining phase, PT MNO who is trusted to operate an ex-termination oil and gas field in East Kalimantan which has been producing for almost 50 years, is required to find a way to survive until end of contract in 2037 by developing the remaining hydrocarbon resources which become more and more marginal. The project development is proposed as a bundling to allow flexibility during execution phase in selecting the well candidates based on recent data acquired from previous wells drilled, hence reducing the risks.

Field Development Package (FDP) 2.3 is prepared as part of PT MNO long term plan and commitment after receiving incentive from Government of Indonesia in 2021. According to the Company Guideline, a risk register is mandatory to be developed since beginning of project which covers risks identification, risks analysis, and risks evaluation. The project team is also responsible to define risks treatment to manage the risks borne by the project. This is in line with the requirement for Good Corporate Governance, where risk management is introduced since beginning of the project life-cycle.

This study covers the risk assessment on the basis of selected project scope which has been validated technically. The risk assessment will determine the major risks in FDP 2.3 considering available historical data of oil price, drilling cost realization, and facility cost realization. These risks need to be monitored to ensure the FDP 2.3 will create value for the shareholder as per plan or avoid loss at the minimum. The most important risks concluded in this study is oil price lower than economic assumption, production target not achieved, and no fix gas sales contract to absorb production. The company may focus in these risks for the risk management of future project development.

Keywords: Mature Fields, Marginal Resources, Risk Management, Top Risks.

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I. Introduction

The oil and gas industry has a strong relationship with uncertainty and risks. As non-renewable energy sources with the availability of resources that are invisible as it is underneath the surface, it involves a high degree of uncertainty in its development. This is mainly related to estimating the reserves and forecasting the physical volume of oil and gas by years for production profile.

The industry also has a high degree of capital intensity in its investment, making it a high-risk business. Thus, the industry needs to assess the economics of a project and develop a set of risk management including from risk identification up to risk treatment to help minimize the risk of doing the business.

These activities need to be integrated from the beginning of the project life cycle and documented in the project investment plan.

II. Business Issue Exploration

The MNO block in Kalimantan, is one of the oil and gas field in Indonesia which has been producing since 1974. The gas production from this block has passed the production plateau and been in high declining phase since 2010.

PT MNO was established on 29th December 2015 to response the nomination of the National Oil Company by the Government of Indonesia to continue the operation of MNO block. In order to secure the baseline production, PT MNO continues the development of MNO block with the Field Development Package 2.0 series. The FDP 2.0 series consists of FDP 2.1 (infill), FDP 2.2 (green field project and lowering

pressure), and FDP 2.3 (infill). Infill drilling development consists of drilling number of wells in an area to improve sweeping efficiency where well spacing is reduced to provide access to un-swept parts of a field.

A. Field Development Package 2.3

The FDP 2.3 requires to get approval for Final Investment Decision (FID), while the approval from the government itself has been acquired in December 2021. The project (infill drilling) contains wells with less stakes compared to the previous FDP. Hence, the challenge lies to ensure valuation of the project still provide positive values for the shareholders by considering the associated risks in the project investment.

As part of risk mitigation, the FDP 2.3 is proposed as a bundling consists of 86 wells from 6 fields in MNO block. Cost component consists of Capital Expenditure (Capex) and incremental Operating Expenditure (Opex) including estimated funding for Abandonment and Site Restoration (ASR). The capex comprises of two components, drilling expenditure (drillex) and surface facility expenditure (surfex). The cost estimation is developed based on PT MNO database, thanks to historical data and typical drilling architecture and surface facility (well connection). The estimated cost is up to 390 million USD with 86% of the investment related to drilling expenditure.

B. Conceptual Framework

Developing marginal resources in mature oil and gas field, especially one which is expected by the government as part of the company commitment after receiving incentive grant can be more challenging than usual development. In one side, the availability of the wells candidate with good economics are limited, yet on the other side certain number of wells and reserves need to be proposed and proved to be economic. Risk management will play an important role to ensure the FDP 2.3 can be executed and value propositions can still be maintained or even be increased and loss to the company can be minimized.

Opportunities and threats can be identified, evaluated, and further developed into business cases where company may authorize projects and programs which provide deliverables, outputs, and outcomes to operations.

Along the course of project or program execution, company will have to pay attention for Health, Safety, Security, and Environment Management to ensure the projects and programs are implemented properly to avoid major health/ safety accident and environmental pollution which eventually not only affecting the project concerned but also the overall company business.

Stakeholder management is highlighted specifically since agreement should be sought among the project's key stakeholders, especially decision makers on the project's constraints and relative priority to form a solid foundation for decisions and subsequent actions intended to foster success. All in all, the risk management is critical to increase the likelihood of achieving project's objectives where identified risks and options for addressing each risk should be an integrated part of the project's plan.

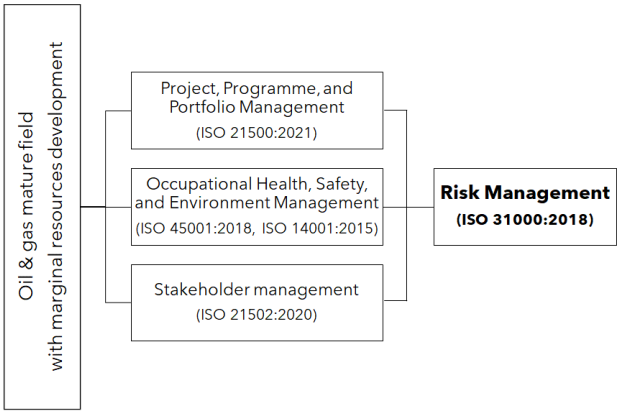

Fig. 1. FDP 2.3 Risk Management Conceptual Framework.

C. Research Methodologies

This study aims to identify, analyze, evaluate, and mitigate the risks in FDP 2.3 infill drilling project in oil and gas mature field with marginal resources. A research method is implemented in order to achieve the objective and answer the research questions to provide benefit for the company.

The study will start by reviewing literatures or international standards related to project management, HSSE management, and risk management. This is performed as a basis to understand the agreed standard among business worldwide for project management, HSSE management, and risk management.

Data collection will be performed using questionnaire as primary data where survey will be conducted to expert representative such as risk owner, petroleum architect, and petroleum economist who are involved in the development and planning of the project as well as in the monitoring nd reporting of an investment plan like FDP 2.3. While for secondary data, it will be collected from external publication as well as data from the company. The data collection covers historical of oil price i.e., Indonesian Crude Price (ICP), drilling cost realization, facility cost realization, etc. All of these data will be analyzed to provide a basis for determining the major risks in FDP 2.3.

III. External And Internal Analysis

A. External Analysis

PESTEL Analysis is used to identify the important factors and trends that might affect the FDP 2.3 execution. The summary of highlighted factors is shown in Table III.

1) Political Factors

Political factors result from the processes and actions of government bodies that can influence the decisions and behavior of firms (Rothaermel, 2021). In the context of upstream oil and gas industry in Indonesia, SKK Migas as an institution that was formed by Government of Indonesia since 2013, holds important roles for the upstream oil & gas development project.

In line with the long-term plan of upstream oil and gas to reach 1-million-barrel oil per day and 12 thousand MMscfd gas in 2030, SKK Migas has demonstrated full supports for oil and gas field development which favorable to the FDP 2.3 proposed by the company.

2) Economics Factors

Macroeconomics largely affects economy-wide phenomena and company external's environment. The five macroeconomics factors affecting firm strategy includes growth rates, level of employment, interest rate, price stability, and currency exchange rates (Rothaermel, 2021). The oil & gas industry differs significantly from all other types of commercial enterprise (Seba, 1993). It is the world's most important internationally traded commodity which modern people takes completely for granted an uninterruptable supply of hydrocarbon fuels from transportation up to electrical power generation.

After more than 2 years since the COVID-19 pandemic emerged at the end of 2019, the global economic conditions are still marked by the high risk of uncertainty despite the economic recovery. According to World Bank data and several other institutions such as IMF, OECD, and the Bloomberg consensus, the world economic growth in 2021 is at 5.6-6.0%, compared to -3.1% in 2020. The commodity price is still volatile including oil price which currently increased, yet predicted by IMF will decline in 2026. This in line with Petroleum Finance study that conclude oil pricing cycles averaged about every seven to nine years from peak to peak.

3) Sociocultural Factors

Society's cultures, norms, and values are captured as sociocultural factors. The global movement for cleaner and renewable energy has more or less affecting the expectation of Indonesian people for the activities done by the National Energy Company and its subsidiaries. However, the society yet has limited choice in searching and determining the energy source for their daily life. The society also learned that oil and gas industry involve high risk activities related to Health, Safety, Security, and Environment (HSSE). Hence, operational excellence to maintain good HSSE records such as no fatalities, no major incidents are highly expected.

4) Technological Factors

The oil and gas industry has acquired the reputation of being among the most "technology driven" of all commercial enterprises. The fact that oil and gas business have high degree in capital intensity, has required the industry player and its suppliers performed continuous innovations to minimize risks and be cost-efficient. Advanced research in machine learning for instance will change the way oil and gas industry works and faster, which will provide opportunity. The continuous development in technology such as satellites, global positioning systems, remote sensing devices, and 3-D and 4-D seismic technologies also provide opportunity to discover oil reserves while drilling fewer exploratory wells, hence potentially less investment required.

5) Ecological Factors

Industry nowadays is expected to bring sustainable economic growth by providing more efforts towards natural environment. Oil and gas industry has been long known to make life easier, yet its exploration and production may have negative effects on the environment. Global movement towards cleaner and renewable energy give pressure to the main players in the oil and gas industry. The transition from oil and gas company become energy company is one of the responses to this global movement. The industry is also expected to implement greener operations while maintaining its economic value.

6) Legal Factors

The outcomes of political process which is manifested in laws and regulations are the legal factors that needs to be taken into account by the company management. With the long-term objective of upstream oil and gas in 2030, any oil and gas development in Indonesia should be supported by the Government. Yet the eco-political movement related to carbon pricing may pose a threat for upstream oil and gas company as it may affect the economics of a project.

TABLE I: PESTEL ANALYSIS FDP 2.3

Aspect		Description
P	Political	GoI target for 1-million-barrel oil per day and 12 thousand MMscfd gas in 2030; Incentive granted by GoI for PT MNO in 2021
E	Economic	Improving ICP trend
S	Sociocultural	Community expectation for cleaner energy and renewable energy
T	Technological	The development of machine learning for faster subsurface interpretation
E	Ecological	Global action towards net zero emission and cleaner energy
L	Legal	Carbon tax implementation in Indonesia

B. Internal Analysis

Core competencies is a unique strength, embedded deep within a company, and are critical to gaining and sustaining competitive advantage (Rothaermel, 2021). As an upstream oil and gas company, PT MNO has advanced experience and knowledge both in subsurface, drilling, surface facility construction, and HSSE.

1) Subsurface

The reserve realization is better than prognoses. This shows that the subsurface analysis is improving by time thanks to previous drilling data which can be used to calibrate the subsurface interpretation despite the reserve become more marginal. (Thurber, 2010) acknowledge that the magnitude of risk is a function of the maturity of exploration and production program, where uncertainty decreasing as knowledge and experience acquired over time and reserves are proven commercially.

2) Drilling

Having drilled around 80–100 wells per year with more than 2000 wells by now, gives PT MNO a competitive advantage in terms of knowledge, technical feedback as well as cost optimization roadmap. Most of the time the cost realization is lower than the initial estimate. This is possible to achieve thanks to continuous optimization efforts through the drilling roadmap with industrialization well design.

3) Surface Facility Well Connection

Surface facility design for wells in MNO block are made industrialized, meaning one design can be copied for many wells. Several industrialized designs include 3rd CP, free slot, mono to bi-slot, and CP suspended Wellhead platform. With this industrialized concept, the realization of well connection is varied, yet in average is still lower than the initial estimate.

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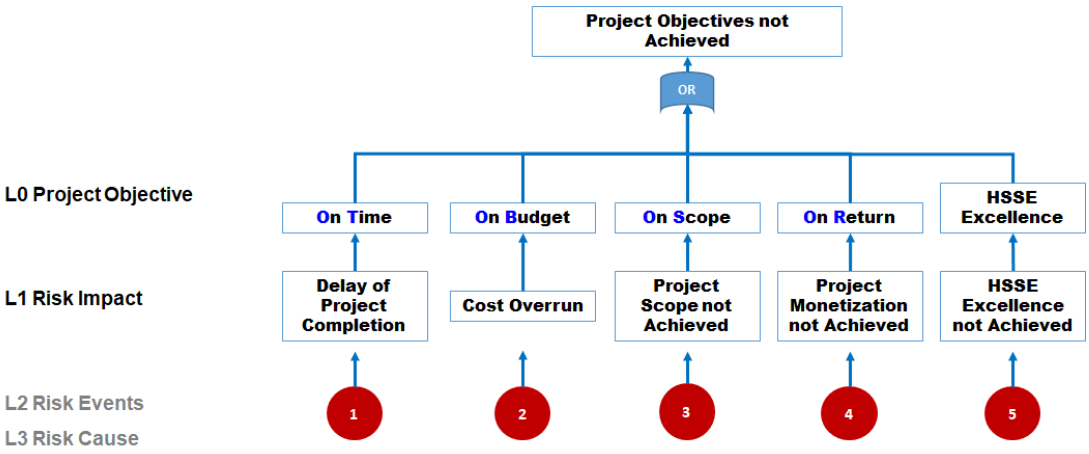

Fig. 2. Fault Tree Analysis for Risk Identification in FDP 2.3.

4) HSSE management system

PT MNO has implemented HSSE Management System with the application of ISO 45001: 2018 Occupational Health and Safety Management System and ISO 14001: 2015 Environmental Management System. In its daily activities, Company HSSE Management System has been implemented widely in the organization. The recent HSSE performance demonstrated good achievement in its operational activities where infill drilling is one of the main activities.

IV. Risk Assessment

Risk Management is a systematic approach to maximize the positive while controlling the negative impacts of risks (Lee, 2021). In order to perform the risk management process, ISO 31000:2018 will be used as a guideline where it provides a Risk Management framework that can be applied to any organization at any level, including project level.

The risks in FDP 2.3 are identified based on project objectives OTOBOSOR + HSSE Excellence using Fault Tree Analysis combined with brainstorming method and company checklist. The risk events are then categorized based on risk category according to company guideline.

A. Risk Identification

1) Business risks (BR)

Business risk includes the risk of failing to achieve business targets due to inappropriate strategies, inadequate resources or changes in the economic or competitive environment. The infill drilling such as FDP 2.3 is one of the strategies to maintain the production level and was already initiated since PT MNO takes over the operatorship of MNO block in 2018.

Volatility can be also an opportunity when considering current situation with post pandemic economy recovery and geo-political issue between Russia-Ukraine. The business risk events that may affect the project are more related to external factors such as oil price that may go below economic assumptions and global gas/ LNG demand.

2) Technical risks (TR)

Technical risks are risks associated with knowledge and technical aspects including understanding, reproducibility, and the like. It includes but not limited to scope definition, stakeholders' requirement, estimates/ assumptions, technical process, technology, technical interface, performance & reliability, and quality.

Even though PT MNO has just become operator since 1st January 2018, however the business process and most of the employees are those who works with previous operator. Hence, the competence and working cultures are still maintained within the team. However, the risks are still existed related to achieving production target, number of wells drilled, and higher operating cost.

3) Management Risks (MR)

Risk associated with ineffective, destructive, or underperforming management are classified as Management risk. It covers risk associated with project in managing its fund (financial), project management itself, portfolio management, operation management, organization, resourcing, communication of project information, and fraud.

Infill drilling has become ongoing business for PT MNO as an effort to maintain production level against high decline rate due to mature field. New well development business process with weekly coordination between multi entities in the company have been established since years and become the key success of the drilling program execution. The potential risks related to this aspect are delay in drilling, delay in well connection, overrun of drilling cost, and overrun in well connection cost.

4) Commercial Risks (CR)

Any risks associated with commercial activities are classified as Commercial risks. This includes risks related to contractual terms and conditions, internal procurement, suppliers & vendors, subcontractors, client/ customer stability, and projects partnership.

The FDP 2.3 utilizes existing contracts for both drilling and well connections since the activities are ongoing business of the company. Material used for this project are typical material taken from stock since the well architecture and well connection design has been industrialized. However, the risks occurred during renewal of contracts and new material procurement. The commercialization of the product both oil and gas will follow current strategy in MNO block with "permanent" demand from the industry in East Kalimantan.

However, there is both risk and opportunity in the gas commercialization according to commercial portfolio with some portion allocated for spot market (no firm gas contract for certain production volume).

5) External Risks (ER)

External risks are risks associated with external parties or condition. It includes legal/ regulatory risks, politic & social risks, market risks, project site/ facilities, and competition.

Some of the wells in FDP 2.3 still requires an environment permit (addendum RKL/RPL) approved by Ministry of Environment. While for execution, each well need to have Authorization for Expenditure (AFE) approved by SKK Migas and technical permits (dredging permit, dumping permit, etc) which need to be processed in advanced prior to the drilling schedule. The risks include delay in permit approval, AFE approval, higher abandonment funding, and community relations and social issue.

6) Health, Safety, Security, and Environment Risks (HR)

This risk category is quite straightforward, covering all risks related to health, Safety, Security, and Environment (HSSE). This includes risk of having major accident (blow out), environment pollution, health problem (global pandemic), and security threat.

As infill drilling have become routine activities, all procedures and contingency plans are already well established and understood by all employees and contractors. However, continuous socialization and reminder are to be performed to prevent complacency risks as wells as to ensure any new employees and contractors understand the procedures and contingency plans. The summary of risk events can be seen in Table II.

B. Risk Analysis

Based on the risk events identified in previous section, risk analysis is performed to understand the nature of risk and its characteristics including the level of risk. The purpose of risk analysis is also to determine whether the risks need to be mitigated, avoided, or accepted as it is.

Using the Analytical Hierarchical Process (AHP), the risk analysis is modeled into hierarchical model as can be seen in Fig. 3. The first level of AHP will be the project risks as per categories identified (Business risk, Technical risk, Management risk, Commercial risk, External risk, and HSSE risk). The second level will contain the risk events in each category, while the likelihood and impact will be used as alternatives.

TABLE II: LIST OF RISKS IN FDP 2.3

Code	Risk Events	Risk Impact
BR-1	Oil Price below economic assumption	Project return not achieved
BR-2	Global gas/ LNG lower demand	Project return not achieved
TR-1	Production target not achieved	Project scope not achieved
TR-2	Number of wells drilled not achieved	Project scope not achieved
TR-3	Higher operating cost	Project return not achieved
MR-1	Delay in drilling	Late project completion
MR-2	Drilling cost overrun	Cost overrun
MR-3	Delay in well connection	Late project completion
MR-4	Well connection cost overrun	Cost overrun
CR-1	Delay in procurement	Late project completion
CR-2	No firm gas contract	Project return not achieved
ER-1	Delay in permit	Late in project completion
ER-2	Delay in AFE	Late in project completion
ER-3	Higher Abandonment & Site Restoration (ASR) funding	Project return not achieved
HR-1	Major accident, e.g., blow out	HSSE excellence not achieved
HR-2	Environment pollution	HSSE excellence not achieved
HR-3	Health problems	HSSE excellence not achieved
HR-4	Security threat	HSSE excellence not achieved
HR-5	Complacency	HSSE excellence not achieved

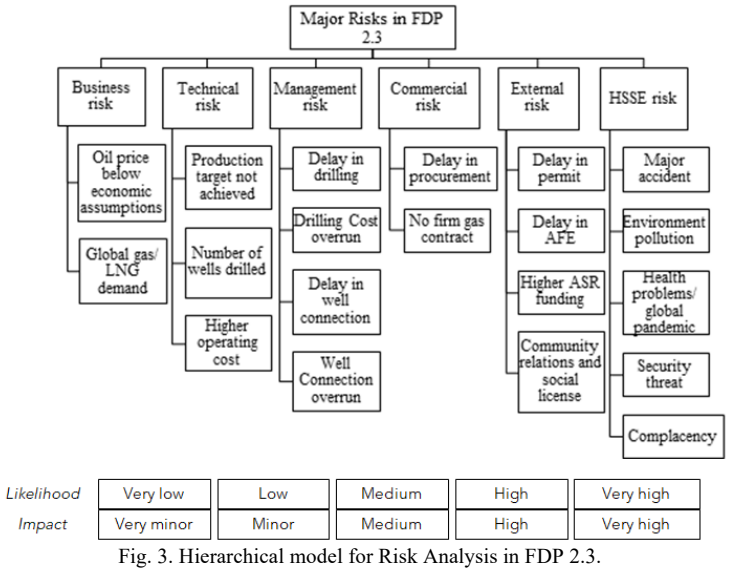

Fig. 3. Hierarchical model for Risk Analysis in FDP 2.3.

C. Risk Evaluation

To support decision, risk evaluation is performed by comparing results of the risk analysis and the established risk criteria to determine whether additional actions are required. Typically, this exercise will lead to a decision to either do nothing further, consider risk treatment, undertake further analysis to better understand the risks, maintain existing control, or reconsider objectives.

Using the combination of weight (global percentage) from the second level of AHP analysis and the likelihood and impact acquired from the Focus Group Discussion (FGD/company's expert judgement), the risk profile of each risk event is shown in following table. Risk priority number is calculated by multiplying the weight (global percentage) with likelihood and impact. The risk event is then ranked based on this RPN to get the most important risks in FDP 2.3.

To define the most importance risks, Pareto rule is used. The idea in Pareto analysis is that 80% of the problems are produced by 20% of causes, or in other words by doing 20% of the work, one can tackle the 80% of the problems. This results the most importance risks in FDP 2.3 are: Oil price below economic assumption (BR-1), Production target not achieved (TR-1), No firm gas contract (CR-2), Drilling cost overrun (MR-2), Delay in procurement (CR-1), and Global gas/ LNG demand (BR-2). This is in line with the 2nd level of AHP analysis described previously.

D. Risk Treatment

Risk treatment aims to select and implement the options for addressing risk. In this section, risk treatment options will be selected by balancing the potential benefits derived in relation to the achievement of the objectives against costs, efforts, or disadvantages of implementation.

The risk treatment measures may include to accept, to avoid, to mitigate, to transfer, to use contingency, to exploit, or to enhance. According to (ISO 31000, 2018) options for treating risks may involve one or more of the following:

1) Avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk.
2) Taking or increasing the risk in order to pursue an opportunity.
3) Removing the risk source.
4) Changing the likelihood.
5) Changing the consequences.
6) Sharing the risk (e.g., through contracts, buying insurance).
7) Retaining the risk by informed decision.

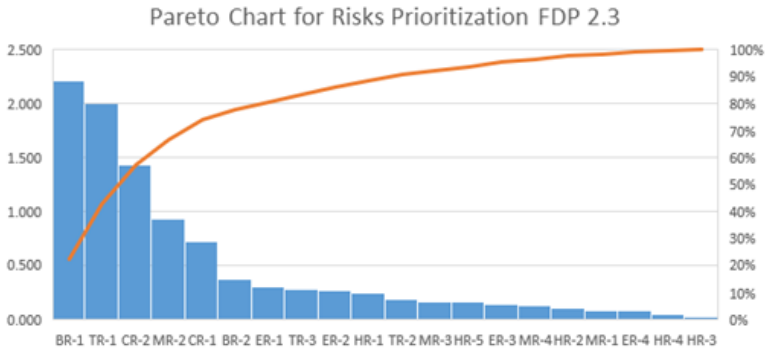

Fig. 3. Pareto Analysis for Risks Prioritization in FDP 2.3.

TABLE III: RISKS TREATMENT IMPLEMENTATION PLAN IN FDP 2.3

No	Risk Event	Why	What	Who	When	Where	How
		RPN/ Level	Action plan	Entity in charge	Timeline	Record	Strategy
1	Oil price below economic assumption (BR-1)	2.214/ Moderate to High	Reduce impact: Operation plan, Commercial plan	Commercial, Development & Planning	2023 (execution)	Project monitoring	Hold production when low oil/gas price
2	Production target not achieved (TR-1)	2.001/ Moderate to High	Reduce impact: Portfolio Diversification	Subsurface	2023 (execution)	Well package, AFE	Well-Field diversification
3	No firm gas contract (CR-2)	1.436/ Moderate to High	Reduce likelihood: Commercial plan	Commercial	S2-2022 (prior to execution)	Rolling Forecast	Portfolio diversification
4	Drilling cost overrun (MR-2)	0.931/ Moderate to High	Reduce impact: Project management	Drilling	2023 (execution)	Project monitoring	Close monitoring, optimize well design
5	Delay in procurement (CR-1)	0.718/ Moderate to High	Reduce impact & likelihood: Stakeholder management	Drilling, Project, Supply Chain	S2 2023 (prior to end of contract for rigs & construction)	Contract Committee	Negotiation for price, update economic calculation
6	Global gas/ LNG lower demand (BR-2)	0.373/ Moderate	Control/ exploit impact: Operation plan, Commercial plan	Commercial, Development & Planning	2023 (execution)	Project monitoring	Hold production when low gas/ LNG demand
7	Higher operating cost (TR-3)	0.278/ Moderate to High	Reduce impact: Perforation portfolio, Contract negotiation	Subsurface, Well intervention	2023 (operation)	OPEX monitoring	Trial for new technology with less cost
8	Major accident (HR-1)	0.247/ Moderate to High	Reduce likelihood: HSSE management	Drilling, Project, Production, HSSE	Continuous	HSSE dashboard	Maintain good HSSE culture, socialization
9	Complacency (HR-5)	0.157/ Moderate to High	Reduce likelihood: HSSE management, HC program	HSSE, HC	Continuous	HC record	Refresh knowledge regularly

9	Complacency (HR-5)	0.157/ Moderate to High	Reduce likelihood: HSSE management, HC program	HSSE, HC	Continuous	HC record	Refresh knowledge regularly
Cont. of Table III							
10	Higher ASR funding (ER-3)	0.141/ Moderate to High	Reduce likelihood: Stakeholder management	Development & Planning	2023 - 2027	Annual Work Program & Budget	Economic calculation, technical discussion
11	Environment Pollution (HR-2)	0.106/ Moderate to High	Reduce likelihood: HSSE management	Drilling, Project, Production, HSSE	Continuous	HSSE dashboard	Maintain good HSSE culture, socialization
12	Delay in drilling (MR-1)	0.085/ Moderate to High	Reduce impact: Project management	Development & Planning, Drilling	2023 (execution)	Project monitoring	Close monitoring

V. Implementation and Recommendation

A. Implementation Plan

Based on the risk evaluation done in this study, twelve risk events considered very importance for the project will be completed with proposed action plan (risk treatment) and timeline. The proposed actions are described as follows.

1) Oil price below economic assumption (BR-1)

The project FDP 2.3 has been demonstrated to be economic on the basis of certain assumptions such as oil price in accordance with the company recent forecast in May 2022. The project revenue depends on the oil price as it also affects the gas price which was calculated using indexation from the oil price. As mentioned earlier, the oil price can actually be threat or opportunity. The risk treatment when the oil price is lower than economic assumption is to reduce the impact, e.g., adjusting production rate/ portion of revenue that is impacted by low oil price. This was also implemented in 2020 where oil price is very low due to global pandemic.

Operation and commercial plan are required to ensure production from FDP 2.3 can be optimized. During low oil price the production can be reduced and vice versa to optimize the revenue. For instance, with the oil price still at 100 USD/bbl, it is recommended to accelerate the drilling of FDP 2.3 which provide higher gas rate.

2) Global gas/ LNG lower demand (BR-2)

The risk relates to project objective to be on return. The risk treatment is to control production when the gas demand is low or exploit the market when gas/ LNG demand around the world is high. This plan can be actualized in the commercial plan and operating plan.

By monitoring the gas/ LNG market, the commercial team may define the commercial portfolio by combining fix contract and spot market. Should the gas demand be very low, the production rate can be adjusted by coordinating with the Operational team. In addition, the drilling plan may be adjusted also by drilling of wells with lower production rate.

3) Production target not achieved (TR-1)

This risk is understood as FDP 2.3 consists of wells with marginal stakes, so the risk of achieving the production target of 86 Bcf is really critical. The risk treatment is to reduce the likelihood by continuous data interpretation from previous drilled wells and selecting wells with highest maturity.

The risk is related to subsurface uncertainty. The abundant subsurface data owned by the company from previous wells drilling is one of the strong risk controls. These data are used by the subsurface engineers to calibrate their model or simulation to define the next well target. Based on experience in MNO block, the realization of drilling in MNO block in overall is still better than prognoses, although some wells are found below the prognoses. The strategy to diversify the wells in the investment proposal such as in FDP 2.3 with 86 wells spread in 6 fields will be the mitigation for this risk.

4) Higher operating cost (TR-3)

Operating cost incremental is used since economic calculation is also performed in incremental basis. The number of well intervention and rate per job are assumed based on the well lifetime. This might be different with what is needed in reality later on. Should the risk occur, analysis needs to be performed to ensure cost benefit of the additional job. Perforation portfolio needs to be adjusted and cost benefit can be performed to justify the additional well intervention job.

One of the challenges in mature field is the integrity of existing production facilities. The cost to maintain the existing facilities is not considered since it is still covered by the baseline production. Thus, risk of higher operating cost for the existing production must be covered in the ongoing business risk analysis.

5) Delay in procurement (CR-1)

The risk relates to procurement of material as well as procurement of new contract for rigs and construction services, which will end in 2024. PT MNO has an established business process in procurement process and also good relation with the vendors or suppliers. Good procurement plan is required to ensure procurement process is on schedule. Stakeholder management is also required to ensure any changes in the regulation that might prolong the procurement process can be anticipated.

6) No firm gas contract (CR-2)

This risk relates to project objective to be on return. The production from FDP 2.3 wells consists of gas, oil, and condensates. The commercialization of oil and condensates follows the current scheme to supply national refinery plants. The location of PT MNO in East Kalimantan with established gas network provides advantages to the company where the market for gas produced by PT MNO is already established.

The fact that one of the current gas sales contracts will end in Dec 2022 actually provide both risk and opportunity. Based on current global geo-politic situation, the gas demand in form of LNG will be still high until 2026. This means LNG spot market is likely to give better price than existing short and medium-term gas sales contract. With the FDP 2.3 started

in 2023, the spot market will bring more value to the project return. Hence, the commercial team needs to closely monitor any change in the global market to adjust the commercial plan accordingly.

7) Delay in drilling (MR-1)

Drilling sequence is used by company for annual reference and is updated in weekly basis considering any updates in the execution. FDP 2.3 has been developed according to assumed drilling sequence. The delay in drilling is considered normal but the effect to the project needs to be monitored to ensure the project timeline is not affected too much and the project return is still maximized. The risk treatment is to reduce the likelihood or impact through weekly coordination.

The new well development business process and weekly coordination meeting are to be maintained to manage this risk.

8) Drilling cost overrun (MR-2)

FDP 2.3 is and infill development, hence drilling cost comprise of 86% of the total investment cost. In order to maintain the project cost, it starts by ensuring the drilling proposal is prepared as required and close monitoring on the drilling progress is done. Continuous drilling optimization will also minimize this risk. The risk treatment is to control through existing project monitoring system.

9) Higher ASR funding (ER-3)

Abandonment & Site Restoration funding is assumed according to certain technical aspects and execution strategy. The funding itself will be done in annual basis based on agreement with SKK Migas. This risk can be treated by reducing the likelihood through good stakeholder management supported with sound technical justification.

10) Major accident (HR-1)

Oil and gas activities such as drilling, construction, and the production itself are high risk activities. The drilling activities itself is one of the riskiest activities as it deals with unknown hazard underneath the surface. This risk is to be treated both by reducing the likelihood of occurrence and reducing the impact with contingency plan.

With years of experiences, good knowledge of the reservoir characteristic, and good HSSE cultures, PT MNO has an advantage that need to be maintained and nurtured. New employees are coming and need to be provided with proper knowledge be competence in doing their jobs. Working procedures need to be respected, HSSE management to be in place, and contingency plan to be ready for guidance for the personnel in case incident happened.

11) Environment pollution (HR-2)

Similar to previous risk, the risk of environment pollution can also be managed by implementing properly the HSSE management plan and contingency plan. Personnel needs to be equipped with proper equipment to combat the oil spill. Other hazardous waste needs to be managed accordingly as per procedures.

12) Complacency (HR-5)

People may have not been affected by a risk event for such a long time that they become complacent. The probability of the risk event occurring may not have changed over that time but their perception of that probability may have done so. This has made complacency as the risk itself. It affects every workplace and employee to different degrees. Regular training as part of human capital program to refresh the knowledge is a way to treat complacency risk. It is important to reduce the likelihood by maintaining supportive workplace.

B. Recommendation

Based on the process implementing the risk management for FDP 2.3 involving company experts (interview, focus group discussion, and questionnaire), some recommendations are proposed for improvement in the risk management process performed by the company:

1) When developing risk register for investment proposal on incremental basis, the company need to involve the operational team and person in charge for risk management of on-going business.
2) The risk assessment results from this study with risk categorization can be used as reference for future typical infill development project with marginal resources. However, it is suggested to keep brainstorming method when developing risk register to update the context and business situation.
3) Incremental risk assessment for mature field has a weakness as it does not consider risk of the existing production facilities. Should the risk assessment be maintained on incremental basis, the risk of baseline production is critical to be developed (ongoing business risks) and to consider impact of the new projects.
4) The risk treatment and residual risks evaluation done in this study is based on qualitative exercise where costs of the risk treatment are not defined in this research. The company may need to further perform risk evaluation in quantitative basis to take into account the risk treatment cost and residual risk that can be accepted by the management.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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