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Mitigating Covid19 Outbreak to Workforce Safety & Health on XYZ Operation Excellence Perspective using Analytic Hierarchy Process

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Abstract - **CVX, Fortune 500 top twenty energy company, has been on a journey to improve return in tough business environment, therefore, XYZ, as CVX subsidiary in Indonesia, need to find the best streamline solution in every business aspect including the challenge on natural gas processing in Northern Area of Operation Department who deals with high gas plant operation & maintenance costs, resources gap, and negative feedbacks from stakeholders. The situation and problem analysis, which were elaborated using fish bone diagram method, confirmed that the most critical issue was field personnel reduction due to Covid19 outbreak which lead to shut down production facilities. From the analysis result using AHP, operation mode change by merging gas plant operation with gathering station where located in the same area is the best solution which can fulfil most of operation excellence focus areas on workforce safety & health; process safety, reliability, & integrity; environment; and efficiency; also, significantly exceeding the other two alternatives: temporary shutdown gas plant operation and outsource gas plant operation. The forementioned temporary solution to mitigate Covid19 outbreak may lead to permanent solution since it improves gas production system value, lowering flaring intensity, and aligned with CVX next five years focuses.**

Keywords - **decision analysis, operation excellence, analytic hierarchy process**

I. INTRODUCTION

PT XYZ (XYZ), one of the biggest Oil and Gas Company in Indonesia who produce 175,000-barrel oil equivalent per day, has been producing natural gas (gas), both associated and non-associated, by recovering millions standard cubic feet of gas per day from all facilities which are located at scattered area spread along light oil mature field in North & South Area as illustrated in Fig. 1. However, gas does not only comprise major amount of short chain hydrocarbon such as methane and ethane (C_1-C_2) and small amount medium chain hydrocarbon (C_3 – C_{10}) but also other impurities such as H_2S, CO_2, H_2O, Mercury, etc. which need to be purified to minimize its side effect, internal corrosion in equipment and pipeline.

CVX, XYZ's parent company, has been on a journey to improve return in tough business environment by having worthy rivals who continue to get better, higher expectations from stakeholders, low oil price environment, and Covid19 outbreak. XYZ, then, need to find the best streamline solution in every business aspect including on gas production in North Area of Operation Department which currently manages the following challenges: steep production decline, high gas plant operation & maintenance costs, resources gap, and negative feedbacks from stakeholders as the internal customers who are mandated to consume the gas minimizing operational expenditure needed to procure natural gas from third parties. Therefore, gas production system is categorized as low priority facilities refer to company business continuity plan and first to be shutdown should any major business disruption such as resource reduction due to COVID 19 pandemic.

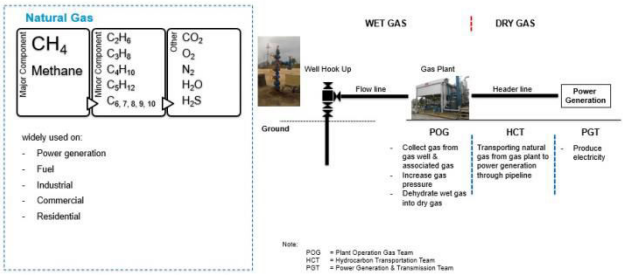

Fig. 1. Natural Gas Production Simplified Process.

XYZ business situation is analyzed by Author as a professional in facility engineering for 5 years and as team leader of gas plant operation 3 years with 15 years of total experience in oil and gas industry. The analysis is then summarized in Table 1 and 2 as the root-cause analysis result by applying Ishikawa's (1976) Fishbone Diagram into five major aspects: Man, Machine, Material, Method, and Environment.

TABLE 1
GAS PRODUCTION ERODED VALUE SCORE

No	Causes/Issues	Urgency	Trends	Impact	Score
1	Aging Equipment	1	5	1	7
2	Operating Routine Duty Limitation	4	3	1	8
3	Operator Competency	2	3	1	6
4	Technician Competency	2	3	1	6
5	Gas Production ↓	1	5	2	8
6	Expensive & Enormous Chemical	3	5	4	12
7	Associated Gas ↑↑↑	1	3	2	6
8	End of PSC Contract in 2021	2	4	1	7
9	Covid19 Outbreak	5	5	5	15

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TABLE 2
SCORE CRITERIA

Score Criteria	Urgency	Trends	Impact saving (BOEPD)	Cost (%)
1	Years	Very Low	< 1,000	< 5
2	Half-years	Low	1,000 – 2,000	5 – 10
3	Quarters	Medium	2,000 – 3,000	10 – 15
4	Months	High	3,000 – 4,000	15 – 20
5	Weeks	Very High	> 4,000	> 20

The major root cause that causes eroding gas production system value with high urgency to be solved, rising trend likelihood and greatest impact is Covid19 outbreak impact on the availability of fit for duty operator as the from liner of Operation Department. Therefore, among other issues the forementioned problem is prioritized to be solved by changing production facility operation mode, from its process, functionality, area, and/or resources party. Several methods of operation mode change can be evaluated to select the best streamline to solve the problems and meet the KPI using multi criteria analytic hierarchy process as the decision-making method.

II. METHODOLOGY

A. Model Selection

AHP method, one of MCDM with a basic approach to decision making which is designed to cope with both rational and the intuitive to select the best from several alternatives evaluated with respect of several criteria using simple pairwise comparison judgments which are then used to develop overall priorities for ranking the alternatives [1], is selected considering all developed alternatives have intangible properties of criteria and sub-criteria and the writer knowledge and experience about the problem in XYZ gas production system to develop a thorough structure of relations and influences. Author also has access to knowledge and experience of others in the Company to assess the priority of influence and dominance among the relations in the structure, also allowing for differences in opinion with an ability to develop a best compromise focusing on the goal of solving the problem.

B. Criteria Definition

Company Operation Excellence (OE) is designed to achieve world-class performance by promoting the systemic management of workforce safety and health, process safety, reliability and integrity, environment, efficiency, security, and stakeholder. Company OE - the main guideline of hazard recognition, risks identification & understanding, and safeguards application & assurance - is then used to develop criteria and sub-criteria.

OE has 6 focus areas: Workforce Safety & Health; Process Safety, Reliability & Integrity; Environment; Efficiency; Security; and Stakeholders to be used as the criteria and sub criteria which can be categorized into following BCOR category:

a. Benefit: environment, stakeholder, process safety, reliability, & integrity
b. Cost: operation expenditure & resource efficiency
c. Opportunity: asset optimization
d. Risk: workforce safety & health

The Covid19 mitigation shall be aligned with Company policy to provide a safe and healthy workplace for the employees and contractors through managing safe work, occupational hygiene, fitness for duty and worker health, and transportation focus program to prevent illnesses, injuries, and fatalities.

Covid19 mitigation shall be aligned with Company policy to prevent and control incidents related to process safety, the release of hazardous energy and/or material, through reliability program execution to maintain full asset life cycle of equipment, component & system and through design principles, engineering, and operating practices of integrity management.

Covid19 mitigation shall be aligned with Company policy to protect the environment and community health using a risk-based management referring to environment design standard. Company commits to do business in environment responsibility ways by including environment as one of decision-making criteria, reducing footprint, operating with care, and steward operation sites.

Covid19 mitigation shall be aligned with Company policy to use energy and resource efficiently to continually improve and drive value by addressing energy efficiency in facility design and systematically manage throughout the lifecycle of assets to improve operational performance. Resource efficiency and asset optimization are intended to maximize value, increase profitability, and drive asset lifecycle management through the efficient utilization of assets and resources (material, people, and time).

Covid19 mitigation shall be aligned with Company policy to manage social, political, and reputational risks and business opportunities related to communities, government, and other external stakeholders.

C. Alternative Generation

Considering problem urgency, immediate forum group discussion at Operations North Team was held and concluded that three possible alternatives were observed to mitigate Covid19 outbreak to workforce safety and health at gas production system in XYZ: temporarily shut down gas plant, outsource gas plant operation, and merge gas plant operation to gathering station located in the same location.

The observed alternatives are the fastest doable solution referring to Company business continuity plan and operation excellence perspective. Alternative selection should also be aligned with the existing Covid19

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outbreak prevention program such as daily monitoring, quarantine, compartmentalization, work from home, and vaccination programs.

Selected Corporate operation excellence guideline and fastest doable solution to sustain gas production system are proposed to be the selection criteria and alternatives to Leadership Team in Emergency Management Team as the decision maker during business disruption period. Having several forum group discussion sessions, the proposed criteria and the alternative were, then, approved to be implemented effective immediately considering Covid19 outbreak impact urgency to workforce health and safety and business.

Alternative 1 is developed to reduce resources gap by temporarily shut down gas plant operation and burn the associated gas at flare stake of each facility, Peta, Pema, and Beka GS. The gas reduction will be compensated by purchasing premium gas from third party using existing contract at $4.1/Mcf and all gas plant resources, team leader, coordinator, operator, plant checker, and assistant can be reassigned to other facilities.

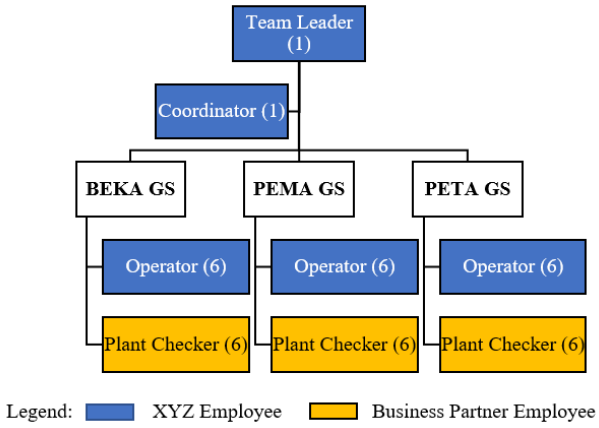

Fig. 2. Gas Plant Resource Reassigned to the Nearest Gathering Station.

Alternative 2 is developed to reduce resource gap by expanding business partner resources to cover all field front liner scope of work under Company team leader and coordinator supervision. Owned gas lifting cost will be slightly reduced from current lifting cost at $2.29/Mcf coming from XYZ salary saving and other gas plant resources, operator, can be reassigned to other facilities.

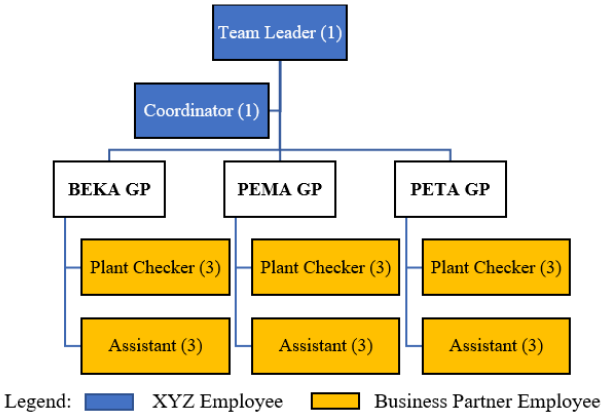

Fig. 3. Gas Plant Operated Utilizing Business Partner Resources and Company Resources Reassigned to the Nearest Gathering Station.

Alternative 3 is developed to reduce resource gap by merging gas plant to the nearest gathering station, Beka, Pema, and Peta so that 1 operator per shift handles both gathering station and gas plant operation supported by plant checker at each facility. Owned gas lifting cost will be slightly reduced from current lifting cost at $2.29/Mcf coming from XYZ salary saving.

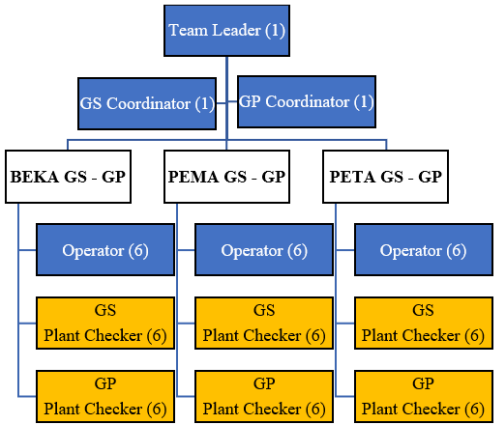

Fig. 4. Gas Plant & Gathering Station Merging Operation Mode

D. Expert Profile and Data Gathering

XYZ experts, shown in Table 3, to provide qualitative judgment using pairwise comparison of criteria and alternatives are selected referring to their expertise, relevancy with the research, and experience duration. The experts comprise management and professional contributors in gas production system operation, maintenance, engineering, and asset development team. The survey result is expected to be comprehensive and minimizing possible biases in the decision-making process by setting several stakeholders as the experts in the same function.

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TABLE 3
EXPERTS EXPERIENCE AND QUANTITY

No	Title	Years of experience	Quantity
1	Manager Operation / Maintenance / Asset	>20	3
2	SFO Advisor	>20	1
3	Team Leader Operation	>15	6
4	Team Leader Maintenance	>15	4
5	HES Coordinator	>10	1
6	Facility Engineer	>5	11
7	Petroleum Engineer	>5	4
8	Process Improvement Facilitator	>5	1
9	Senior Operator	>15	1
	Total		32

Considering Covid19 outbreak prevention protocol in Company workplace which limit offline meeting, experts' opinions were gathered via online form using Microsoft Teams application. Every pairwise question was designed using 2 questions using rating choice due to software limitation to make a pairwise question in one question completed with highlight explanation for each question and section. However, some experts were still need guidance in providing score using AHP frame through phone conversation by simplifying the choice into the odd number as the first approach then the even number as the second approach if needed.

E. Model Implementation and Consistency Check

Problems can then be more easily be comprehended and evaluated by converting into numerical values and processed to rank each alternative on a numerical scale after problem decomposition into a hierarchy of goal, criteria, sub-criteria, and alternatives using AHP following steps [2].

First, after completing AHP models for the decision, data corresponding to the hierarchic structure in the pairwise comparison on a qualitative scale are collected from experts or decision-makers. The pairwise comparison of various criteria are organized into a square matrix where its diagonal elements are "1". The criterion which has value greater than 1 is more favorable than other criterion, either in row or column and the matrix elements in other half of matrix diagonal have reciprocal value.

Second, the relative importance of the various criteria and sub criteria in the termed of weight and alternative in the termed of rating which being compared are obtained from principal eigenvalue and the corresponding normalized right eigenvector of the comparison matrix.

Third, matrix inconsistency, obtained by comparing matrix consistency index with random matrix, is tolerated to max. 0.1 and may need the experts to re-examine the answer to comparison.

Fourth, to obtain alternatives rating, the rating of each alternative is multiplied by the weight of sub-criteria and criteria, aggregated to get local rating with respect to each sub-criteria and global rating with respect to the weight of the criteria.

Some adjustment was made to ensure consistency. First adjustment in main criteria between process safety and environment considering failure in process safety such as leakage or loss of containment will also impact to environment directly.

Second adjustment in pairwise comparison between Alternative 1 to Alternative 2 in Managing Safe Work perspective from preference in Alternative 2 to preference in Alternative 1 to maintain consistency considering Alternative 1 is more preferred since plant checker has not been qualified to supervise managing safe work activities although they have already pass managing safe work training and have moderate competency.

Third adjustment in pairwise comparison between Alternative 1 to Alternative 2 in Workforce FFD perspective from preference in Alternative 1 to the same importance between alternative to maintain consistency considering workforce will still face the same Covid19 hazard exposure in their assignment in other team.

Fourth adjustment in pairwise comparison between Alternative 1 to Alternative 2 in Reliability perspective from preference in Alternative 2 to preference in Alternative 1 to maintain consistency considering Maintenance Team also has the issue with fit for duty technician to maintain facilities reliability, temporary shutdown gas plant can make them focus to the higher production facilities reliability maintenance.

Final adjustment in pairwise comparison between Alternative 1 to Alternative 2 in Workforce FFD perspective from preference in Alternative 1 to preference in Alternative 2 to maintain consistency considering idle facilities have less integrity than operated facilities since idle facilities do not have preventive maintenance program.

III. RESULTS

Criteria weight and alternative local rating are summarized in Figure 5.

Workforce safety and health is identified as the most dominant criteria of operation excellence during Covid19 outbreak, divided evenly for managing safe work and fit for duty sub-criteria. The second dominant criteria of operation excellence are process safety, reliability, integrity, and environment. The last ones are efficiency and stakeholder.

Alternative 3 merge GP & GS operational has the higher score of final alternative rating outscoring the other two alternatives: temporary shutdown GP and outsource GP operational. Summary of priorities of alternatives: ALT 1 Temp. Shutdown GP is 0.174859, ALT 2 Outsource GP Operational is 0.204541, and ALT 3 Merge GP GS Operational is 0.620600.

Sensitivity analysis is calculated to know whether ALT 3 merge GP – GS operational would have been the best choice if all criteria would have had the same weight, 0.2. Summary of priorities of alternatives

from sensitivity analysis: ALT 1 Temp. Shutdown GP is 0.15653, ALT 2 Outsource GP Operational is 0.23576, and ALT 3 Merge GP GS Operational is 0.60771.

IV. DISCUSSION

Merging gas plant operation to the nearest gathering station is the selected alternative for mitigating Covid19 to workforce safety and health in gas production team. Temporary merging operation mode of gathering station and gas plant in Peta, Pema, and Beka will minimize resource gap supported with plant and well checker readiness in each facility and field operation, respectively.

Cost benefit analysis is obtained from calculating benefit-cost ratio (BCR) to summarize the overall relationship between the relative costs and benefits of a proposed alternatives. BCR can be expressed in monetary or qualitative terms. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors.

Benefit margin is obtained from the between margin of the avoidance of oil loss production projection and operation cost to execute the alternatives and summarized in Table 4.

Company needs to make resource change management during selection, transition, and implementation phase. In selection process, employee transferred to a team has considered previous work experience, competency skill set, and familiarity with facility, field, and other team members. To ensure smooth transition, all reassigned employees should prepare handover checklist, competency check list by new leader, short service employee program, coaching and mentoring.

This alternative also solve employee reassignment complexity since oil facility is relative easier to be operated than gas facility by maintaining most of gas plant operator to still work at gas plant and expanding their scope of work to include gathering station operation in Peta, Pema, and Beka, and it is the most efficient solution since Company can still produce associated gas for electricity generation with more than 10% lower cost coming from the reduction in salaries & benefit.

Considering issue urgency, merging operation preparation, employees selection, and transition process shall be completed within one month. Implementation will be divided into two phases with three-month duration for each phase to review and lookback process. Besides review and lookback result, the program continuation will also be synchronized with XYZ Covid19 emergency management team progress on Covid19 vaccination program. If vaccination program for front liner employee can be finished within the next six months, the operation mode can be resumed to previous operation mode.

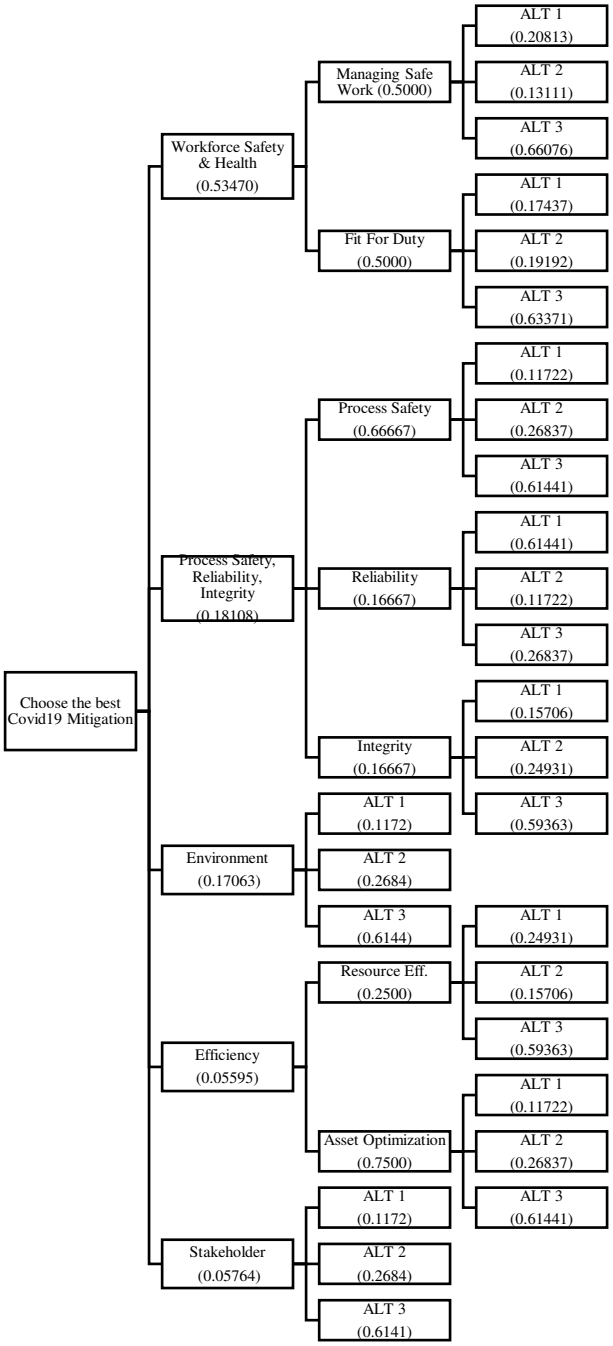
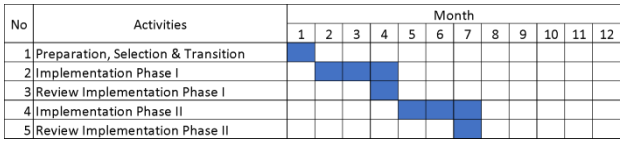


Fig. 5. Summary of Criteria Weight and Alternative Local Rating

TABLE 4
ALTERNATIVE COST BENEFIT SUMMARY

Parameter	ALT 1	ALT 2	ALT 3
Benefit (overcoming all gas production system symptoms)	H	M	M
Cost (BCR)	13.41	24.01	24.01

Note: H (High) M (Medium)



No	Activities	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Preparation, Selection & Transition												
2	Implementation Phase I												
3	Review Implementation Phase I												
4	Implementation Phase II												
5	Review Implementation Phase II												

Fig. 6. Implementation Plan

V. CONCLUSION

Company hosted lasted 2021 annual Investor Day, where summed up Company commitment to shareholders with four simple words: "Higher Returns, Lower Carbon" to emphasize Company commitment to build on our track record of capital and cost discipline to deliver higher returns and the actions taking to advance a lower carbon future.

Company outlined key financial goals based on $50 Brent: more than double return on capital employed (ROCE) by 2025, grow free cash flow more than 10% per year by 2025, and double synergies from merger & acquisition activities.

Company also reinforced energy transition strategy, which is focused on delivering a lower carbon future that benefits shareholders, society, and the environment. Company expects to achieve a 35% carbon intensity reduction by 2028 from 2016, by lowering targets for oil and gas GHG intensity, flaring and methane intensity.

Considering the strategy to untap the potential gas reserved and successful merging operation at Peta, Pema, and Beka as the main levers – revenue/gross margin; reliability; OPEX – to improve capital efficiency and further lowering costs, our temporary solution may lead to permanent solution to improve gas production system value by reducing operation cost by 10% from employee salary and lowering flaring intensity since it is aligned with both Company focuses in financial and environment in the next five years.

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