Proceeding Book of ***The 6th ICMEM 2021****, 11-13 August 2021, Bandung, Indonesia*
ISBN*: 978-623-92201-2-9*

Effective and Efficient CGS Strategy to Mitigate NDC Unplanned Total Shutdown: A Case in PT. Capital Petroleum Indonesia

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Abstract − **Nowadays, the Duri POD (Plant Operations Duri) operates four Central Gathering Station (CGS) which receive produced fluids from producer wells, post workover wells, and new drilled well. Every CGS treats and distributes the soft water, good oil to customers, and sends the excess treated water to disposal facilities.**

NDC (North Duri Cogeneration) consists of three units Heat Recovery Steam Generator (HRSG) and use soft water to produce steam. 2 (two) historical cases were happened in the period of year 2017 and 2019 related to NDC unplanned total shutdown caused abnormal condition at CGS Duri and necessitated to shut in producer wells with production loss value reach out USD 1 MM.

By combining Value-Focused Thinking (VFT) "alternatives generator" and Analytic Hierarchy Process (AHP) "Alternative's selection". There are the three options proposed to alleviate the excess water issue, namely turning the steam generator back on, Continuous Buffer and Instantaneous Buffer Use, and Partial Shut-in Producers well. The result is steam generator back up has the best option and implement communication protocol for resolving the issue.

Keywords - **Abnormal Condition, NDC, CGS, Fishbone Diagram, VFT, AHP**

I. INTRODUCTION

PT. Capital Petroleum Indonesia (PT. CPI) emphasizes the importance of work safety for every employee in each task implementation. One of the company's activities is implementing a safety program. In essence, the safety program is directed at three targets, namely health, environmental and production. These three elements have an equally important role and must be in harmony in creating a safe working atmosphere. PT. CPI has been implementing work safety in its business strategy for a long time, but with new environmental issues, this company also plays an active role in implementing policies concerning the environment and work environment.

Protecting the environment is about overcoming problems related to pollution such as soil pollution by oil spills or oil dumping into the forest, contamination of production water that is allowed to be injected into the ground. The parameters for the success of the HES (Human and Environmental Safety) program are:

1. No produced water is discharged out (ZEWADI)
2. Zero oil spill
3. Zero Motor Vehicle Crash (MVC)
4. There is no deforested area
5. Comply with all government regulations

Abnormal conditions will have an impact on safety, the environment and production. For this reason, making the right decision is very important so that the impact can be minimized. 2 (two) historical cases were happened in the period of year 2017 and 2019 related to NDC unplanned total shutdown caused abnormal condition at CGS Duri and necessitated to shut in producer wells with production loss value reach out USD 1 MM.

The aim of this research is to conduct a Decision Analysis for the purpose of evaluating alternative short-term solutions to minimize irregular events at CGS duri during the unplanned shutdown of the NDC. Based on the generated decision criteria, the best option will be chosen.

II. LITERATURE REVIEW

This chapter will describe the theory on four key points that will assist readers in comprehending the study, namely CGS Duri process flow, North Duri Cogeneration (NDC), zero water discharge (ZEWADI), and about the analysis tools: Value Focused Thinking (VFT) and Analytic Hierarchy Process (AHP).

A. CGS Duri Process Flow

Central Gathering Stations (CGS) flow process shown in figure 1 were designed to separate and treat produced fluids, to store and even to ship good oil, soft water, and excess water. The fluid separation operations run continuously and so the products transfer and distribution operations. CGS receives the fluid produced from the production well to be separated and the result is sent to the next process. Fluids treated in CGS consist of 3 phases: liquid, solid, and gas. In the first stage after the fluid undergoes temperature adjustment in the Heat Exchanger, the produced gas/ associated gas is released from the fluid when the fluid is processed in the boot/ degasser boot. After the gas is released in the gas boot, the fluid is then drained into the FWKO (Free Water Knock Out) tank for the release of free water content. From the FWKO water leg, the water produced as a result of separation in FWKO is then drained to the API Separator pit, then pumped to the MFU (Mechanical Floatation Unit) to lower its oil content. Wet crude from FWKO is then transferred to Wash Tank to extend the stay time (settling time) from wet crude so that the crude is spilled from the wash tank to the shipping tank Basic Sediment & Water (BS&W) or the water content according to customer request (<0.8%). The initial

ISBN*: 978-623-92201-2-9*

process for the preparation was to lower the oil content in the water to <3.0 mg/l. The treated water is then pumped to the Oil Removal Filter (ORF to reduce the oil content to 0.0 mg/l. From ORF the water will enter the softening process (remove the solubility content in the Softener Unit. After the solubility of the water is lowered) it enters the GFW (Generated Feed Water) tank and is ready to be pumped to the NDC and Steam station. Excess treated water will be pumped to the Disposal Injection Facility (DIF) and Central Injection Facility (CIF) and then injected into the disposal wells.

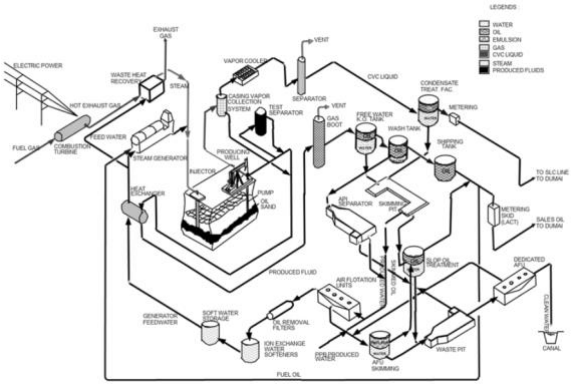

Fig. 1. CGS Duri Process Flow

B. North Duri Cogeneration (NDC)

NDC Power Plant consists of three units Heat Recovery Steam Generator (HRSG) shown in figure 2 which Efficient process to simultaneously produce electricity and steam:

- Steam is a by-product of the 316 MW electricity generation Exhaust gas from the electricity generator's turbine is directed through a heat exchanger vessel
- Can produce up to 350,000 bbls of steam per day as per current request, NDC produce around 300,000 bbls of steam per day.
- Largest heat recovery steam generators in the world. Greater than 25% savings versus conventional steam generators
- Provides additional export oil for the Government of Indonesia

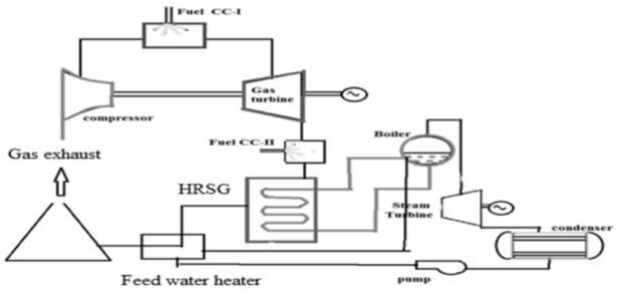

Fig. 2. Combined power plant with HRSG.

C. Zero Water Discharge (ZEWADI)

Instead of dumping generated water into the environment, it is re-injected into the ground to generate more oil. PT. CPI has effectively met and exceeded the Government of Indonesia's environmental legislation by implementing ZEWADI.

The rest of the operating needs will be injected into the disposal well whose allocation and licenses have been approved by SKK MIGAS and KLH (Kementerian Lingkungan Hidup). This program aims to ensure that all processed water is not wasted as per instructions by the Decree of the Minister of Environment for waste treatment.

D. Analysis Tools

In this research, process to identify possible causes (Root Cause Analysis) until select the best alternative (using AHP) is conducted using Focused Group Discussion. A focus group discussion (FGD) is a good way to get people together who have common perspectives or experiences to discuss about a particular subject. A moderator (or group facilitator) leads the group of participants, introducing subjects for discussion and assisting them in having a vibrant and natural discussion among themselves. the conceptual framework is as follows:

1) In the 1960s, quality management pioneer Professor Kaoru Ishikawa invented Root Cause Analysis, also known as Cause-and-Effect Analysis. He published "Introduction to Quality Control" in 1990, which defined the technique in detail. Ishikawa Diagrams of Fishbone Diagram of caused-and-effect analysis is utilized to perceive the root reason of business problem.
2) Value Focus Thinking (VFT) is a way to illustrate ideas and method that allows you to get higher options while solving problems. VFT technique is utilized to get numerous options and criteria. VFT is an innovative approach that focuses on the various decision goals and how to derive as many alternatives as possible from them.
3) The Analytic Hierarchy Process (AHP), developed by Thomas Saaty in 1980, is a theory of measurement based on pairwise comparisons that relies on expert judgment to generate priority scales. Analytical Hierarchy Process steps method is used to determine the best alternative as follows:
    a) Structuring Hierarchy Tree.
    b) Generate Pairwise Comparison Matrices
    c) Synthesizing to determine the best alternative.

III. METHODOLOGY

A conceptual framework or research methodology is a tool to analyze several variations and contexts as shown on figure 4, it is used to visualize an idea and prepare concept. A research methodology is designed

ISBN*: 978-623-92201-2-9*

to set out the flow process for each of the steps in the development of the solution, as shown in Figure 3. The research design on this chapter will give an explanation for the trouble confronted by means of enterprise, diverse tools and strategies to perceive and close the distance with a purpose to accumulate an intention. The uncontrolled excess water is one of the symptoms that made CGS abnormal. Ishikawa Diagrams of Fishbone Diagram of reason-and-effect analysis is utilized to perceive the root reason of business problem. After the root purpose recognized, the author will expand numerous feasible alternatives and criteria to be used and carried out to clear up commercial enterprise trouble and attain business goal. Value Focus Thinking (VFT) technique is utilized to get numerous options and criteria. the author will then use Analytical Hierarchy Process (AHP) approach.

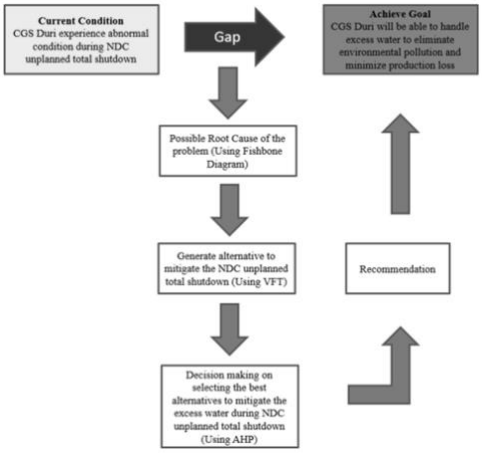

Fig. 3. Research Design

IV. FINDINGS AND DISCUSSION

The aim of this study is to develop mitigation to overcome excess water at CGS Duri during NDC unplanned total shutdown that meets the expectations of all stakeholders. Value Focused Thinking (VFT) is a framework that was chosen based on this research to ensure that the alternatives produced for decision making will serve the expected value in a systematic method. Figure 4 depicts the process flow of alternative generation using VFT in form of FGD, which begins on the right (fundamental objective) and moves to the center (criteria for consideration) before ending on the left (enlist executable options to achieve the goal).

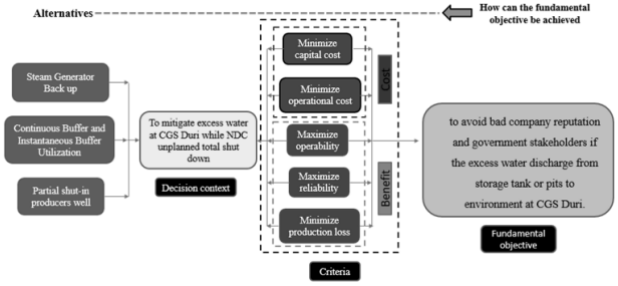

Fig. 4. Alternative Generation Process

We now know the criterion weight for each alternative and objective after completing all pairwise comparisons up to the consistency check for each alternative and objective. The weights of the parameters are summarized in Figure 6. The next step is to synthesize all of the criterial weights, then multiply each criteria weight by the alternative rank on those criteria to get the best alternative to mitigate excess water at CGS Duri during NDC unplanned total shutdown. The best alternative is the one with the largest total amount of weighted aggregate value.

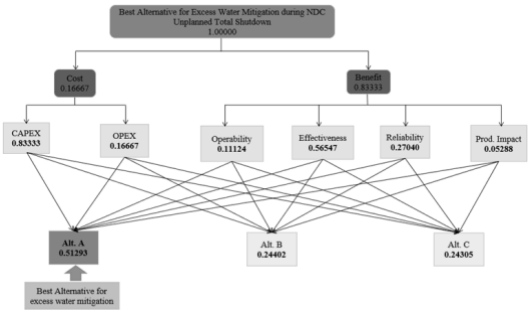

Fig. 5. The Ultimate Result's Weighted Hierarchy Tree

Figure 5 shows Alternative A as the best alternative for mitigate excess water at CGS Duri during NDC unplanned total shutdown after calculating the weighted aggregate value of each alternative in relation to the objectives.

V. CONCLUSION

The CGS Duri of PT. Capital Petroleum Indonesia facing challenging problem due to inadvertently rapid accumulation of excess water occur during NDC unplanned total shutdown, this event problem may result in production losses because the company will need to shut down an oil producer well to control excess water. The excess water could be uncontrolled by a number of factors, including:

- The availability and reliability of disposal transfer pump
- Problem on disposal line piping system
- Abnormal heavy rain with long duration

The solution came with a chosen alternative rank through the AHP method to reduce excess water at CGS Duri during the unplanned total shutdown of the NDC. Alternative A is the best option for resolving the issue, and it has the highest ranking among the alternatives. To improve performance and control of excess water reduction. Communication protocol is required to manage excess water distribution inter CGS during abnormal condition happen, heat is also maintained to support oil-water separation by continuously produce steam. shut in producer well need to implement if all resources had been utilized prior to reduce excess water to keep ZEWADI at

ISBN*: 978-623-92201-2-9*

CGS Duri.

ACKNOWLEDGMENT

The author wishes to express his gratitude to Dr. Eng. Manahan P. Siallagan, S.Si, M.T, M.Sc, who served as the project's supervisor. In terms of the decision-making definition, his guideline has proved to be detailed. Ari Yunianto and Kukuh Kurnianto, the author's work supervisors, deserve special thanks for allowing the author to pursue postgraduate studies.

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