Analysis of transport loss in the distribution of fuel products on tankers and terminals of fuel terminals in Eastern Indonesia region

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Submission date: 20-Feb-2023 07:40AM (UTC-0500)
Submission ID: 2018794756
File name: 5.0113770.pdf (996.29K)
Word count: 4966
Character count: 24895

AIP Conference Proceedings

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Cite as: AIP Conference Proceedings **2675**, 050002 (2023); https://doi.org/10.1063/5.0113770
Published Online: 14 February 2023

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Analysis of Transport Loss in the Distribution of Fuel Products on Tankers and Terminals of Fuel Terminals in Eastern Indonesia Region

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Abstract. Petroleum is an important commodity in Indonesia that should contribute greatly to public welfare. The idea of having social welfare was declared at the opening of the 1945 constitution. Thus, the petroleum sector has a significant contribution in realizing the prosperity of all Indonesian citizens. In fuel and gas transactions, the handover processes have transport losses potential on the ship distribution of fuel. The depreciation in the transactions of fuel and gas is also commonly referred to as the difference in the quantity at the time of loading (R1) and at the time of discharge (R3). The difference in the loading until the discharged of the ship to the terminal (ship figure in barrel) being the issues raised with the aim of (1) the procedure of Pertamina Holding in determining the policy of transport loss R1=0.2% R2=0.07% R3=0.2% and R4=0.47% on fuel transportation on the tanker. (2) then the factors that cause shrinkage on fuel loading after loading and after discharge. (3) The efforts made by the Officer to perform an emphasis in inhibiting the occurrence of transport loss on the ship. This study used qualitative and quantitative approaches, which utilized secondary data (questionnaire, interview, observation) and primary data (related documents). One hundred twenty respondents/ship crews were involved in the data collection that provided the structured statements. In addition, there were 15 ships as the population, and five of them were chosen as the samples in this study. The results of this study provide the answer to all three problems, the policy of transport losses set in the Pertamina guidelines No.A-001/H10200/2007-S4 should be temporary due to the assumption that if this is enforced, it will be used as the opportunity of cheating on the board. Moreover, the cause of the transport losses consists of (1) the discrepancy found of the tank material, which was not adequate according to the type of the load,15 vessels being the populations have the iron/steel material; (2) the operational age of the vessels. Nine vessels have been operated above 20 years, three ships of up to 25 years, and three vessels above 15 years. In the survey asking if the age of the vessel can affect the shrinkage, the respondents responded with 56.3% agreed, only 10.6% did not agree, and 4.7% undecided; (3) shipping distance, the interviews with some respondents, and the daily journal documentation of vessels showed the documentation of weather condition changes in the 24 hours; (4) the temperature change, the highest risk of depreciation is avtur, followed by Gasoline RON 88, followed by Diesel Fuel and Gasoline RON 90, because every 1ºC will affect the observed loads; (5) the treatment is not sustainable, from field observations and documentation, there is no special care on the tank material in regular basis or periodically. To minimize the shrinkage issues, Officers do the sounding again, calculate the shipping load manually, pay attention to the temperature outside/inside of the load tank and make a Notice of Readiness (vessel) and letter of protest (terminal).

INTRODUCTION

Petroleum is an important commodity in Indonesia that could contribute greatly to community welfare. The idea of having social welfare was declared at the opening of the 1945 constitution. Thus, the petroleum sector has a significant contribution in realizing the prosperity of all Indonesian citizens[1]. Pertamina Holding, as the fuel and gas company, experienced six decades already in the energy industry owned by the Government of the Republic of Indonesia with the business scope consisting of business in the upstream sector, including the exploration and production of fuel, gas, and geothermal which were performed both inside and outside the country[2]. In the

The Proceedings of The 5th International Conference on Maritime Education and Training (The 5th ICMET) 2021
AIP Conf. Proc. 2675, 050002-1–050002-9; https://doi.org/10.1063/5.0113770
Published by AIP Publishing. 978-0-7354-4321-1/$30.00

transactions of fuel and gas, generally in each of the handover processes, there is potential for transport loss, which is commonly referred to as the difference in the quantity at the time of loading (R1) and after the discharge (R3). Many factors cause transport loss, such as the presence of density, temperature difference, cheating, or the occurrence of the difference in measurement tools. It does not solely occur due to a real loss but also an apparent loss. Generally, the transport loss in fuel transactions happens because of the real and apparent loss. The real transport loss occurs due to the basic nature of the fuel, such as evaporation and pipe leak. Meanwhile, the apparent transport loss is happening because of the inaccuracy in the fuel itself, for example, the difference in measurement tools. The researcher had experience working at MT. Laju Prakarsa II as the Chief Mate. The vessel was owned by Laju Prakarsa Holding, with the address on Jl Pasar Ikan - Jakarta Utara. Pertamina Holding operated the vessel as the charterer to cover the distribution to some depots in the eastern region of Indonesia such as Sorong, Biak, Manokwari, Namlea, Saumlaki, Tual, Dobo, and Merauke. The fuel distributed to the community is in the form of Gasoline, Diesel, Avtur, and Kerosine. Wayame - Ambon Port as the loading port. Wayame Port surely serves some of the ships in carrying out fuel distribution in the eastern region. At the time, researchers as the Chief Mate has the responsibility in the process of loading and unloading of fuel onboard, in one voyage, the distribution of fuel can be two to three homeports to do the discharge, for example, Wayame Loading Port (Ambon) to Pertamina Depot in Kaimana, Tual, Dobo and the last Pertamina Depot in Merauke. There was always a difference in calculation between the ships and the shore party in the discharge process, which is indicated by the difference of reported load between the ship party and the Officer on the shore. This condition caused a delay in the vessel's operation because of the need to perform the recalculation to minimize the difference in the calculation. The delay of vessel departure made the mooring cost greater. The other operating expenses increased, Not to mention if the shrinkage of the fuel had exceeded the tolerance limit of Pertamina Holding by 0.02 % (R1, R2, R3, and R4), then the vessel/owner would be charged a penalty equal to the value of the shrinkage of the fuel that had been calculated. In addition, the possibility of contamination or mixing of fuel onboard will result in claims of Pertamina Holding to the company of the shipowner with the conditions and terms applied. Based on the background, the writer formulates the problems first, How Pertamina Holding provides the policy of transport loss R1=0.2% R2=0.07% R3=0.2% and R4=0.47% on transporting fuel on the tanker. Second, what factors are causing the shrinkage on fuel loading after loading and after discharge. Third, How Officers perform the emphasis in inhibiting the occurrence of transport loss on the ship, with the expected goals, First, be able to identify the procedure applied by Pertamina Holding in determining the policy of transport loss R1=0.2% R2=0.07% R3=0.2% and R4=0.47% on transporting fuel on the tanker. Second, identify the factors causing the shrinkage on the loading of fuel after loading and after discharge. Third, be able to identify the Officers' efforts in inhibiting the occurrence of transport loss on the ship.

The internship report of students in the Petroleum Engineering study program in 2015, at division ILC Pertamina Internal Audit, Kramat Raya-Central Jakarta revealed that the shrinkage factors of the fuel onboard had been identified, such as the presence of density, temperature difference, cheating (fraud) or the occurrence of the difference in measurement tools[3]. Other things indicated as the cause of shrinkage was the real and apparent loss as the properties of the fuel itself, which indicated by some of the potential fraud/loss which is not apparent is through a piping system

Angie, with her research entitled the factors causing the occurrence of transport loss when loading the gasoline RON 88 on the MT. Merbau ship said that the depreciation of the cargo that occurs in the MT. Merbau was caused by several factors that should be minimized up to the limit of tolerance determined by a shipping company[4]. Two factors affect the shrinkage of the load: physical depreciation, such as evaporation, leakage of the pump, leakage of the pipeline, and the apparent shrinkage, such as measurement error and the error calculation of the load. Then, the way to minimize the shrinkage is to implement the procedures in the loading and unloading process. Palapa, in the research under the title the efforts to overcome the cargo loss Naptha in the MT Gandini vessel stated that the cargo loss Naptha can be avoided by carrying out the cargo operation following the SMS manual of the company, with performing vetting by Pertamina, do the familiarization of the new crew and improve the equipment procurement, measurement and calculation of the cargo based on the standard [5].

RESEARCH METHOD

This study used a primary data collection method obtained from specific topics by considering the information obtained and the secondary data, including the condition on the board or the ship and crews. Then the data were analyzed using the quantitative approach and qualitative approach to describe or give a picture of the object in the study through population data [6]. Data were collected through the distribution of questionnaires and interviews on

the crew as many as one hundred twenty people as the respondents. As many as 24 (twenty-four) samples were selected randomly without setting criteria. The collection of information is used to analyze and learn the attitudes, beliefs, behaviours, and characteristics of some of the main people on the ship and in the organization, which can be affected by the proposed system or the system that already exists. To produce more convincing findings, the interviews were conducted, as additional for the questionnaire distributed to some of the respondents which randomly selected based on the task and responsibility on the ship and from some of the questions in-depth, especially on the crew that has been working for/sailing experience that much longer.

TABLE 1. Respondents' Information

NO	Name of Respondent	Name of Vessel	Position	Contact Number
1	Firman Arham	MT Prestigious	CE	081242852020
2	Rasto Pasae	MT Althea VIII	CO	082393484018
3	Muhammad Basri	MT Ratu Elisabet	Master	081244610616
4	A Sry Nurwinda	MT Nurhasanah V	3 Off	082316424297
5	Issak Essi Manukallo	MT Hy Jade	Master	081339661371
6	Aria Bima Pratama	SPOB Surya Indah	2 Off	082349679360
7	Syamsuddin Jaya	MT Sumber Rezeki 68	CE	085210333377
8	Edwin Pakambonan	MT Catur Samudara	Cadet	085240830629
9	Darni	SPOB SP4 BSI	Master	081241717064
10	Sulham	MT Edricko 1	C-Off	085242398610
11	Rusnar	SPOB Surya Indah 2	2 Off	085230448819
12	Mariadi	MT Grace Pioner	1 Eng	082188803524
13	Hamzah	MT Ratu Ruwaidah	Master	081349498888
14	Syamsul Puasa	SPOB Aqshadewa 77	Master	085345109665
15	Nurmah Khadijah	SPOB SP4 BSI	C-Off	081377723666
16	Jason Fresly Gambira	MT Erawan 99	4 Eng	085340165311
17	Rusdi Sulaiman	MT Seroja 16	C-Off	085213777784
18	Chaedir Ali	SPOB Buana Glory 01	2 Eng	082141937846
19	Bambang	MT Sirius	2 Eng	085395157393
20	Muhammad Arsak	MT Wisdom	C Eng	081342552095
21	M Aras Sulaeman	MT Sentek 33	C-Off	082288352015
22	Joni Sampe Toding	MT Adria	C-Off	081356199331
23	Sealtirl James B	MT Global	2 Off	085240629607
24	Yanto	SPOB Hopper &	C-Off	081342027171

The vessels that became the population in this study were as many as 10 (ten), which the researchers then chose into 5 (five) vessels as the sample.

TABLE 2. The Fuel Transport Tanker

NO.	Name of Vessel	GRT/NRT	Year of Manufacture
1.	MT Michiko XXVII	3331 T	1996
2.	MT Sinar Busan	7687/3266 T	2006
3.	MT Annabella	2826/1462 T	1992
4.	MT Himiko	1071/746 T	2000
5.	MT Althea VIII	3762 T	2002

RESULTS AND ANALYSIS

The researchers conducted the data collection at the Office of Pertamina Holding at Jl Garuda 1 Makassar, and TBBM Makassar, then TBBM Parepare through observation in the field (the ship and the terminal), the distribution of the questionnaire, then collected the information from the literature study and the last, conducted a short interview with the crew and the involvement of the team which collaborates in the activities of loading and unloading of fuel in TBBM (Fuel Terminal)[7-8]. Based on the findings in the field and interviews related to The policy of Pertamina Holding in transport loss R1=0.2% R2=0.07% R3=0.2% and R4=0.47% on the transport of fuel on tankers, according to the Acting Region Manager Marine VII Armin Sirua, regarding the policy about losses transport tolerance set in the Pertamina Guidelines No. A-001/H10200/2007-S4 about the Handling and Supervision of the Shrinkage of Crude Oil and Products issued only for temporary. The adjustment will be made to the policy if needed in an emergency. Shrinkage will occur more frequently in R1 (according to the Bill of lading in the barrel) and R2 (finished loading/the

ship figure in the barrel), where TBBM Makassar is a tank shelter. The difference in the calculation of which result in shrinkage or transport loss on the results of the acceptance from the tanker, of course, followed up with a few things, namely sounding again, inspecting the loading tanks, and doing the calculation again using the ASTM table, checking the temperature, correcting of the trim and the tank table[9]. (source of interviews on June 3, 2021, at the headquarters of Pertamina Holding). While Factors causing the depreciation on the loading fuel after loading and after discharge are as follows :

1. The material of the tank is not suitable for the cargo.

   The fuel transport ships are operated (chartered by Pertamina) in the region of the Integrated Terminal Makassar and Fuel Terminal Parepare. From the field observations, researchers found that from the study population, the ships still have the material of the loading tank made of steel or iron. Also, a ship experienced a change in the cargo function based on the initial purpose of the ship manufacture.

TABLE 3. Specifications of Tank Material of the Ship

NO.	Name of Vessel	Tank Material	Tank Capacity
1.	MT Michiko XXVII	Steel/Iron	55399.86 m^3
2.	MT Sinar Busan	Steel/Iron	12500.067 m^3
3.	MT Annabella	Steel/Iron	5483.245 m^3
4.	MT Himiko	Steel/Iron	-
5.	MT Althea VIII	Steel/Iron	6499.835 m^3

FIGURE 1. Image of Loading Tank at MT Althea VIII and MT Michico XXVII.2021

2. The Operational Age of the Ship.

   The observation results indicate the operational age of the ship above the average age of 15 (fifteen) years and even exceeding 25 years. After reviewing the maintenance document (body repair/docking), the author concluded that the treatment is not carried out continuously. Likewise, a maintenance system of the loading tank does not have any records in writing, and the Officers said that it was never being scheduled/planned because the loading tank is always ready to laden (never has a problem). The tightness of cargo space/tank and piping (for example, main hold), of course, has already started to change because the other rubber and locking are porous due to rusting or corrosion, by reviewing the operational age and ship manufacture. The following is the data of ship according to the year of manufacture.

TABLE 4. Fuel Transport Vessel Based on the Manufacture Year

NO.	Name of Vessel	GRT/NRT	Year of Manufacture
1.	MT Michiko XXVII	3331 T	1996
2.	MT Sinar Busan	7687/3266 T	2006
3.	MT Annabella	2826/1462 T	1992
4.	MT Himiko	1071/746 T	2000
5.	MT Althea VIII	3762 T	2002

The questionnaire results from the respondents who have the competence to give their views and opinions about the interconnectedness of the age of the vessel can affect the tightness of the loading tank, and they have given answers of 85.7% agreed. Only 10.6% did not agree while a 4.7% answered undecided.

3. Shipping Distance

TABLE 5. The Route of Fuel Distributing Vessel

NO.	Name of Vessel	Port of Loading	Port of Discharged	Distance (NM)
1.	MT Michiko XXVII	Makassar	Parepare	128
2.	MT Sinar Busan	Balikpapan	Makassar	302
3.	MT Annabella	Parepare	Donggala	264
4.	MT Himiko	Makassar	Donggala	329
5.	MT Althea VIII	Makassar	Bau-Bau	152

Based on the table of fuel transport in the region of TBBM Makassar and Parepare, they are the charter ship whose operation (the route of the shipping) has been serving distribution points according to the community's needs in the nearby regions of Makassar and Parepare. The cruising range with an average speed of 10 knots will cruise the waters for 1 x 24 hours with the process of calculating the cargo, the loading documents, and the Sailing Permit Letter from the harbormaster. The results of interviews conducted by the author with Mr Aliaman (081228428826), like the Mate on the KM Bonto Haru vessel, explained that the change in temperature and the long distance between the ship and unloading place make the depreciation can not be avoided (July 8, 2021, at 12.00). Thus, the weather and temperature changes will experience some circumstances that can affect the condition of the fuel in the loading tank. The humidity of temperature, the increase in air temperature at the time of weather change will be influenced by the duration of the voyage taken by a tanker, so that the author concluded that the longer the route of the voyage of a ship transporting fuel, it can affect the shrinkage caused by evaporation. The following is the shipping routes of fuel distribution. The table above gives the data of shipping distance of the ship in nautical miles, so it can be described that the average ship has a sailing time of more than 1 x 24 Hours (1 day) with the formula of ETA = Distance (NM)/Ship Speed (average) x 24 H

4. Temperature Changes

The temperature and pressure are very strong factors in influencing the quality and quantity of fuel, particularly on gasoline cargo. Every change of temperature increase by 1^0C will affect 0.12% of the volume of fuel and will affect 0.001 - 0.003 of its density. The high pressure will further accelerate the process of evaporation. Temperature and pressure cannot be separated because every increase in temperature will increase. This can be seen from the other type of light fuel, such as gas in the tube that will burst if heated. For example, the calculation of the gasoline loading on the tanker is :

Known
Density of the Gasoline at 15 = 0.7990 (seen in table 52 VCF = 6.293 by choosing the tank 1 Port.
The volume of Tank 1 Port = 650.124 M^3
Loading Temperature = 28^0 C and Table 54 B VCF = 0.9862
Questioned, How many the capacity of tank 1 with the unit:
Net KL 15 =…..…..?
Barrel =…….?
Metric Ton =…..…..?

Solution
Net KL 15 = Volume obsv x VCF (Table 54 B)
= 650.124 x 0.9862
= 641.152
Barrel = Net Kl 15 x VCF (Table 52)
= 641.152 x 6.293
= 4034.770
Metric Ton = Net KL 15 x VCF (Table 56)
= 641.152 x 0.7779
= 498.752

The results of calculations with Barrel units become the value of the shrinkage terms of the fuel. And the units in the calculation of fuel above used at the time of the calculation of fuel loading by using several indicators, namely :

- List of ullage and volume
- The list of trim correction
- Sounding Table
- Sounding Tool
- Tables (54, 54 B, 53, 52, 56,57)
- ASTM table

In case of a difference between the results of the calculation of Chief Mate with the ship figure on board with the bill of lading that becomes the result of the calculation from the terminal (the shipper), this is what is called transport loss. Table 4.5 provides the percentage data of losses transport that happened on some fuel distributing vessels in TBBM Makassar da Parepare. The data below shows the type of loading of Gasoline RON 88, Avtur, and Diesel fuel with different temperatures and densities of each cargo.

TABLE 6. Percentage (%) of Transport Losses on the Ship

NO.	Name of Vessel	Grade	Density	Temperature (^{0}C)	Percentage (%) Losses
1.	MT Michiko XXVII	Gasoline RON 88	0.7197	30.0	0.17 %
2.	MT Sinar Busan	Bio Diesel	0.8555	31.5	0.21 %
3.	MT Annabella	Gasoline RON 92	0.7472	30.5	0.11 %
4.	MT Himiko	avtur	0.0052	31.5	0.12 %
5.	MT Althea VIII	Gasoline RON 88	0.7197	30.0	0.20 %

The author provides an overview in detail about the influence of temperature on loading and unloading activities. The results of the questionnaire that the respondent had answered showed that 11.8% did not understand, 3.5% answered with undecided and 84.7% fully understood the effect of temperature on the process of loading and unloading activities.

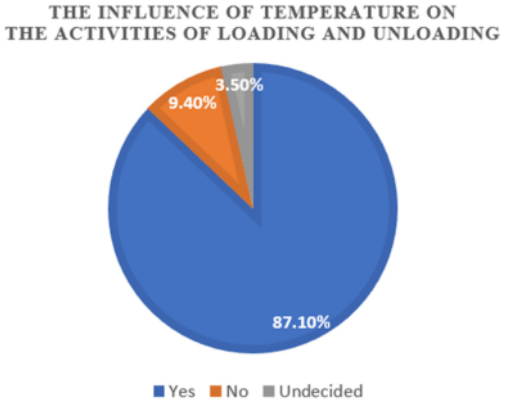

FIGURE 2. Diagram of Questionnaire Results of Temperature

In strengthening the result of the questionnaire, the interviews had been conducted on the fuel distributing ships on TBBM Makassar and Parepare as follows:

1. Agus Salim, the position as the Chief Mate on MT Althea Vessel, had an interview on July 8, 2021, at 08.15 explained that the high temperature would affect the observed so that the numerical calculation is not following the BL from the shipper received by the cargo on board (081342900224)
2. Firman Arham, the Head of the Engine Room on MT Prestigious vessel, had an interview on July 8, 2021, at 18.11 said that evaporation occurs only at the high temperature or above the flashpoint (081242852020).

5. The maintenance is not sustainable.

In maintaining the performance of a ship to ensure the smooth operation of the cruise, it needs efficient and effective maintenance by preventing the risk reduction of function fails to meet the productivity and improved services for the transport of fuel. So the ship owners can perform scheduling planned maintenance (Planned Maintenance System) supervised by Officers through a survey and documented according to the Classification Board of Indonesia, which is mandatory of ISM Code. However, based on the data in the field from several ships which become the population, the maintenance of the loading tank on the ship did not go according to the plan due to some reasons :

- The ship is still considered seaworthy, and they do the loading and unloading because no system has problems. The loading tank does not show real damage (cracking, leaking, etc.).
- The owner of the ship has not been scheduled the maintenance since the contract with the user is still running (on hire),
- Time to have the maintenance and repair was very limited due to the tight operational schedule of the ship.
- The lack of coordination between the ship operator and the company,
- The random operational route of the ship (Tramper) and is sailing a short distance as well as frequent changes in the destination port (Deviation) that complicate the implementation of the schedule of ship maintenance that has been prepared,
- There was still difficulty getting spare parts of the ship's equipment, skills and knowledge of the crew, and the ship's position that far away from the maintenance facilities.
- The factor inhibiting the maintenance is the ship operational serving the route to islands which became the economic center.

Thus, the author concluded that the treatment caused a delay of ship operations, including the transport loss, should be used as a reason for conducting emergency maintenance. However, since the unfamiliarity of Officers and Crew about the expansion and shrinkage of the fuel in the tank due to a decrease in the thickness levels of the steel/iron that already have cavities because not painted regularly, resulting in no maintenance for the vessels.

Then, the next formulation of the problem is the officers' efforts in the performing of emphasis and inhibit the occurrence of losses transport on the ship. The observations and interviews showed that the fuel with an expansion level that resulted in the value of depreciation and their natural properties were essentially Avtur and Gasoline RON 88 followed by Diesel fuel and Gasoline RON 90.

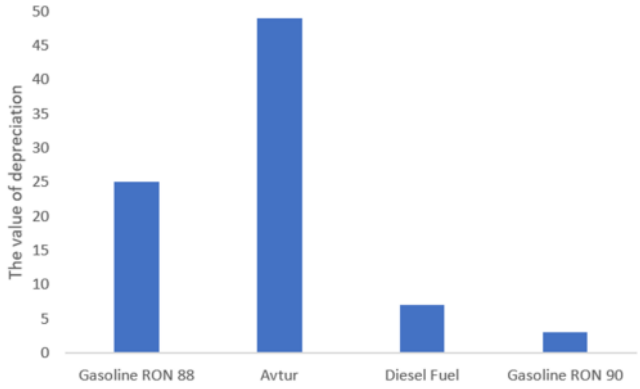

FIGURE 3. The Chart of Depreciation Value on Fuel Loads

In pressing and inhibiting the losses transport on the ship, the Officers performed a few attempts as follows:

- Do sounding reset manually on the loading tanks, which is considered to have the biggest difference in the calculation—then interpolating the results of the initial sounding with the results of the last sounding (don't forget to pay attention to the BKI calibration time in the books of sounding table/loading tank table).

- Do the calculation manually, if the initial result is using the auto computerized system, by manually setting the data taken according to the cargoes' calculation. Based on the results of the questionnaire and the interview with the Officer, if the calculation difference that resulted in the value of losses of transport, then taking the remedial action/correction and have been answered with a percentage below:

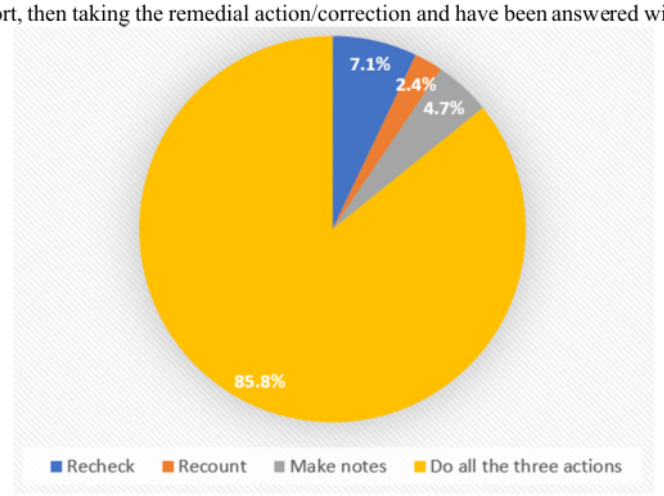

FIGURE 4. Diagram of Questionnaire Result of Chief Mate/Officer Actions

When the onset of calculation difference between the ship (ship figure in units of the barrel) and the terminal (Bill of Lading in units of the barrel), the Chief Mate accompanied by the Loading Master and witnessed by the Surveyor will perform some corrective actions. The data shows as many as 2.4% answered with will do the calculations again, 4.7% create a Notice of Readiness document if there is a calculation difference not stated in agreement, 7.1% also taking steps to recheck again on the loading tanks, and 85.8% Officer's said that they will do the calculation again, do the sounding again and if there is no agreement then the Chief Mate will make the Notice of Readiness and Loading Master will issue a Letter of Protest as a step that is considered as a back up of the difference between the Ship Figure and the Bill of Lading. Thus, many companies owners of the cargo and the agency and Pertamina Holding do not want it to be done because it can be detrimental to the agreement between the two parties.

CONCLUSION

Based on the description in the results of the analysis and discussion part, the author can conclude each of the following problems :

1. Policy on guidelines for the fuel shrinkage in the reception R1=0.2% R2=0.07% R3=0.2% and R4=0.47% is a temporary policy and not enforced legally by some reasons to control the operation of the ship at the terminal.
2. Meanwhile, the factors that cause the shrinkage on the loading of fuel after loading and after discharge are :
   - The material of the tank is not suitable for the cargo
   - The age of the ship
   - Shipping Distance
   - Temperature changes
   - The maintenance is not sustainable.
3. The attempt Officers perform the suppression and inhibit the occurrence of losses transport on the ship, as follows:
   - Do sounding reset manually on the loading tanks, which is considered the biggest difference in the calculation.
   - Do the calculation manually, if the initial result is using the auto computerized system, by manually setting the data taken according to the cargoes' calculation.
   - If no agreement on the value of losses transport, then the Chief Mate will make the NOR (Notice of Readiness) as a form of response from Letter of Protest issued by the terminal

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