

# Improvement on Transportation Safety on Bus by Installing A Speed Limiter in Conventional Engine to Reduce Speed Rate

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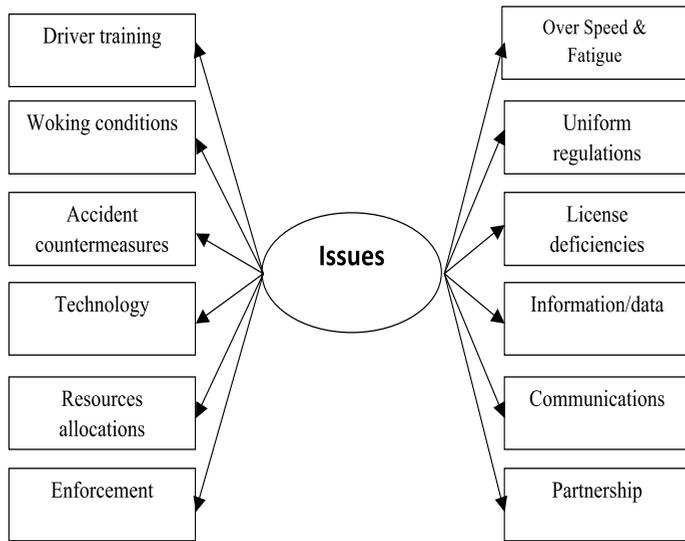
**Abstract.** Driving is one of the conditions when the driver should be given special attention to make the motor vehicle in driving way and the driver should be in a good condition. However, the problem is in a certain condition the driver lost their control speed due to their target and minimize the driving time and it led the high potential to accident. Therefore, speed limiter which applied in the bus is urgently needed to reduce the accident and improve their awareness of road safety. Developed speed limiter is completed by fuel cut-off system to prevent the engine and maintain the speed. Limitation of speed be adapted by government regulation. From the results show that the highest and average speed of 136 km/h and 123.5 km/h is observed by bus speed prior to use speed limiter. After speed limiter applied in the bus, the approved maximum speed is 90 km/h. Those data approve that the speed limiter can reduce 83% from the top speed before speed limiter applied.

## 1 Introduction

National Safety Program. Safety driving is a based principle of transportation. In Indonesia, safety driving almost never happen which cause of road accidents. Based on the report of Indonesia Police department in 2010 that approximately of 31.234 peoples death by road accident. It means that there is 3-4 people death/hours. Decreasing PDB (gross domestic income) of 2.9-3% is one of the issues that influenced by road accident [1]. The driving safety has global issues from past decades and it estimates that 1.3 million people killed due to road accident [2-3]. It become biggest disaster when it not solved. Those data are approved by WHO that since 2030, Highest number of victims are not caused by disease while it caused by road accident [4-6]. There are some factors that led the accident (Fig. 1) and it will become main resources to produce road safety guideline in order to reduce the victims [7, 8].

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**Fig. 1.** Issues of bus accident on the highway [8].

Fig. 1 shows that over speed and fatigue are the most factors that cause the road accident. If approved by the number of bus accidents in West Java Region (DKI Jaya, West Java, Banten province), by the 2010 to 2015 has recorded that approximately of 17% and 20% of bus accident is caused by over speed and fatigue, respectively.

The regulation of motor vehicle. Based on the regulation that issued by Ministry of Transportation, Republic of Indonesia, No.111 mention about regulation for speed of motor vehicle [9 - 11]:

- a. The minimum speed is 60 km/hours and the highest speed is 100 km/hour for a highway.
- b. The highest speed in urban area is 80 km / hours.
- c. The highest speed in central of urban area is 50 km/hours.
- d. The highest speed in settlement place is 30 km/hours.

Through this regulation, the government aimed that it can restrict the speed of motor vehicle. Department of Police mention that at 2011-2013, bus has become most of transport accidents and it recorded that close to 9.278 cases by that time [12].

## 2 Methodology

Installation of speed limiter on the bus. This paper discusses and reviews how to control the speed of the bus before installing speed limiter. There are 300 buses with operating in different route and it divided by 2 classes of routes which are urban route, province route (Java, Bali and Sumatra island). The speed limiter is installed in the engine and it controlled and adapted by government regulation. The basic principle of speed limiter is signed when the bus in over speed. It will automatically cutoff the fuel which caused the bus speed in operated under the top speed regulation. Schematic diagram of speed limiter is shown in Fig. 2.

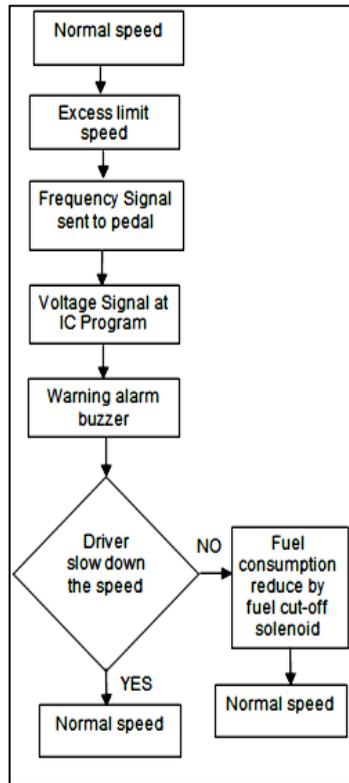


Fig. 2. Schematic diagram of speed limiter.

### 3 Engine speed limiter installation in bus

The modification of the speed limiter installation has been done by improving on electrical wire which placed and connected with the machine. It controlled and developed based on government regulation depending on the urban or highway speed. The speed limiter installation procedure is shown in Fig. 3 and Fig. 4 where it consists of buzzer, ECU, speed sensor, engine and speed limiter control box.

The working of the speed limiter mounted on the machines are inter-city buses, when the vehicle speed exceeds a specified speed limit speed sensor on the transmission output will send frequency signal to accelerator pedal, then the frequency signal is transformed into a voltage signal at IC program. The voltage signal is transformed into the comparators components, forwarded to relay and followed by sound a warning alarm buzzer. When the driver still performs additions speed, fuel shut off solenoid will reduce the fuel consumption into the engine and it will reduce the speed/rpm to the normal speed. Meanwhile, when the driver is slow down the speed, the buzzer alarm will be stop and back to the normal speed.

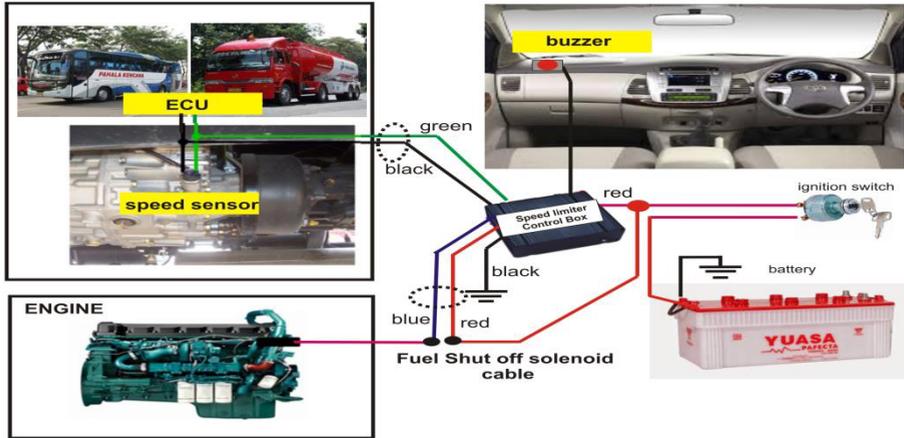
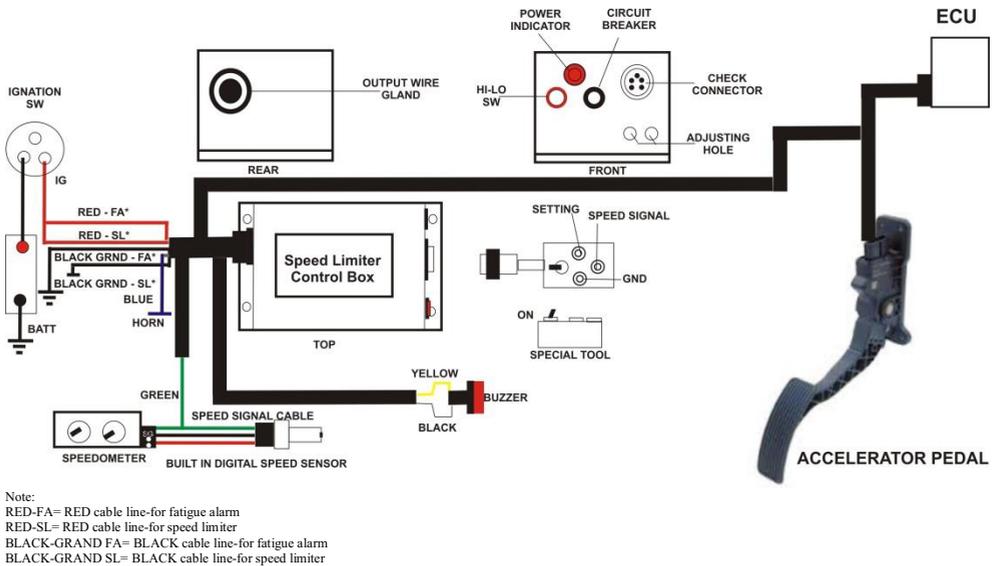


Fig. 3. Diagram Installation engine bus.



Note:  
 RED-FA= RED cable line-for fatigue alarm  
 RED-SL= RED cable line-for speed limiter  
 BLACK-GRAND FA= BLACK cable line-for fatigue alarm  
 BLACK-GRAND SL= BLACK cable line-for speed limiter

Fig. 4. Speed limiter on the engine bus scheme.

### 4 Development speed limiter

The speed of the bus before installing speed limiter. The data on the speed of the bus is monitored by GPS and they have monitored several buses such buses with ID No. is HT 002 ,HT 006, HT 634, HT 674,and HT 691. The speed limiter is not installed on the bus. The highest speed of 136 km/h for HT 691, and the speed flat is 123,5 km/h for HT 674 has been observed and it will very serious thing when that speed is operated in urban areas. The lowest speed is shown by HT 002 with the speed of 120 km/h. The different speed between that bus is influenced by driver behavior or attitude and their time target in order to receive more income. The detail speed data for buses in different route (Jakarta, central java, north java, and Bali) is listed in Table 1. That data is summarized from the daily speed which detail shown in Fig. 5Speed of the bus before installing speed limiter. The data on the speed of the bus is monitored by GPS and they have monitored several buses such buses with ID

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**Table 1.** The average speed of the bus before being installed speed limiter.

No	ID Vehicle	Type Vehicle	Average Speed Bus (Km / hour)	Top speed (Km / hour )
1	HT 002	Bus	110,2	120
2	HT 006	Bus	100,5	122
3	HT 634	Bus	87,2	121
4	HT 674	Bus	99,2	124
5	HT 691	Bus	123,5	136

The speed of the bus after install speed limiter. The comparison between the speed of bus before and after installing speed limiter has successfully done. A speed limit that allowed by government regulation and the company when the driving in highway is 100km/h and in urban street not more than 80km/h. Base of GPS data, when the bus installs by speed limiter in the bus id of HT 002, HT 006, HT 634, HT 674 and HT 691. It shows that highest speed is 90km/h and average speed is 80km/h. The data monitored by 30 days as shown in Fig. 6 and summarized in the Table 2. Top speed allowed when the speed limiter applied is 90 km/h and the lowest speed of 85.4 km/h is shown by HT 634. After installation speed limiter can reduce and make consistent speed of the bus close to 80km/h. It can be improved to blow off to the driver how to drive, when the speed of the bus lock off in 80km/h the alarm will be on in 80db to considering to the driver to take care driving the bus in the highway or urban street. When the drivers try to do acceleration or over speed in driving almost 90km/h, the driver must to strip off the accelerator to off the speed limiter alarm. A speed limiter alarm will be on because the bus is over speed as sign that the driver must reduce the speed.

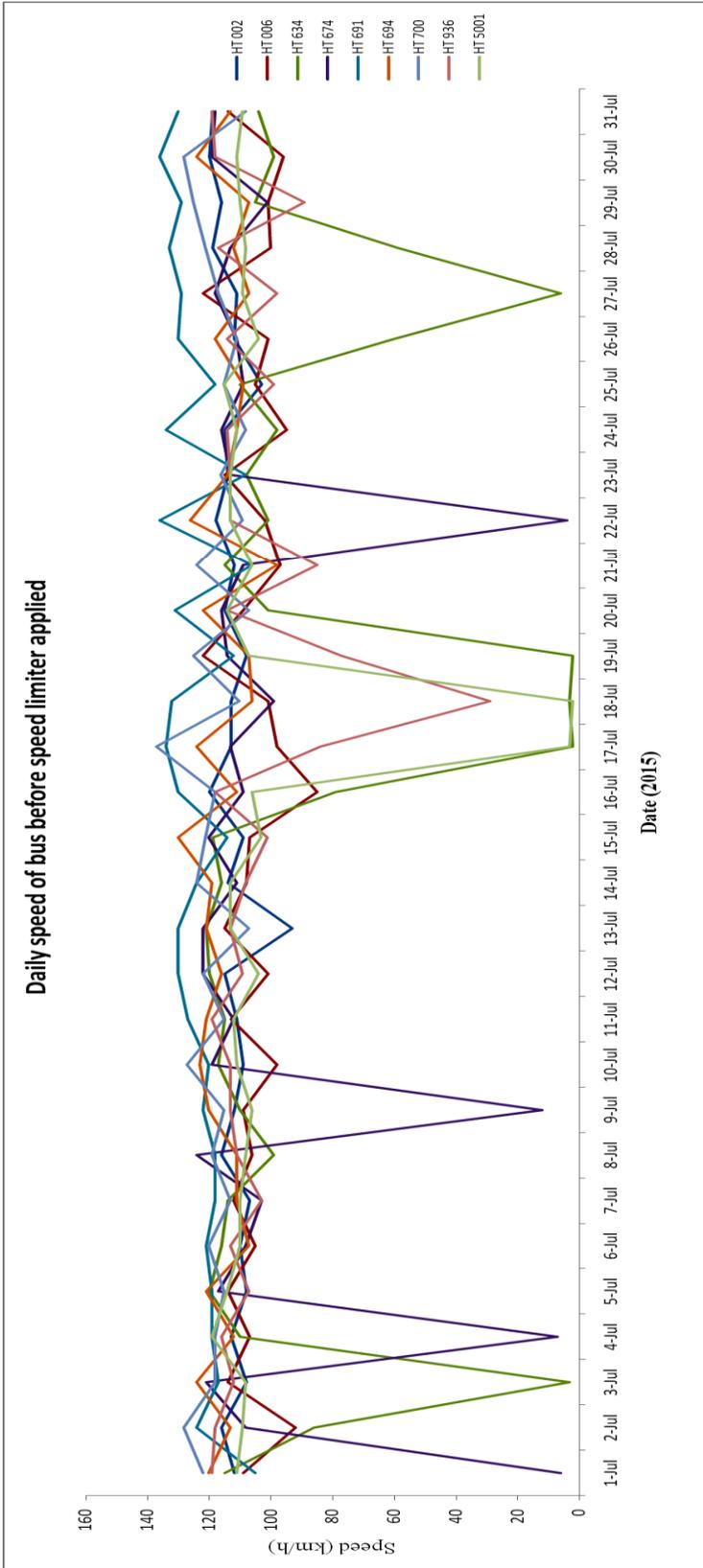


Fig. 5. Bus speed before being installed speed limiter.

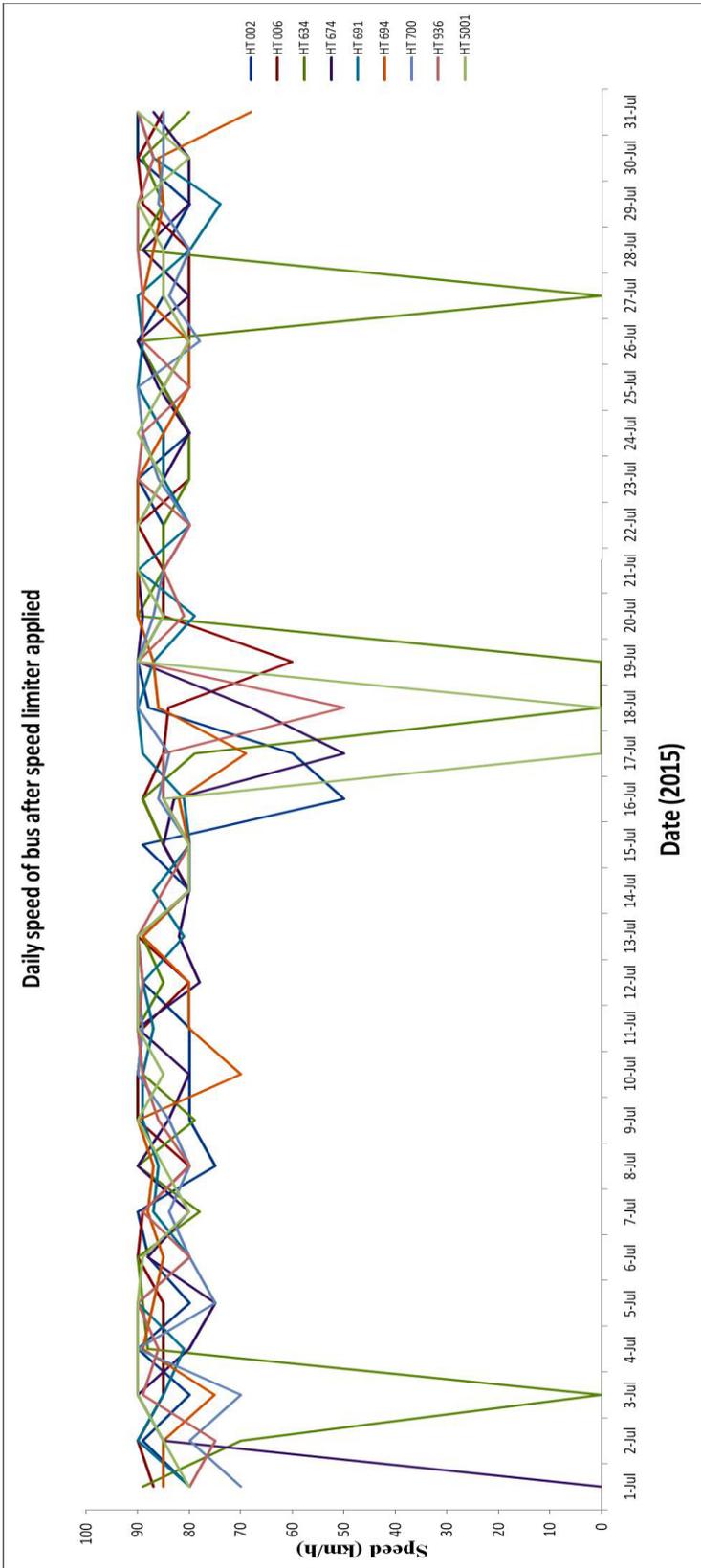


Fig. 6. Bus speed after being installed speed limiter.

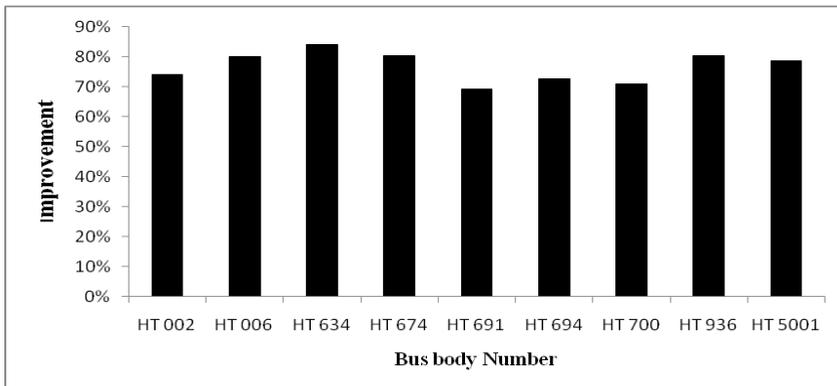
**Table 2.** The average speed of the bus after being installed speed limiter.

No	ID Vehicle	Type Vehicle	Average Speed Bus& truck (Km/h)	Top speed (Km /h)
1	HT 002	Bus	86,3	90
2	HT 006	Bus	87,4	90
3	HT 634	Bus	85,4	90
4	HT 674	Bus	86,6	90
5	HT 691	Bus	88,1	90

The improvement and analysis after install speed limiter. Improved analysis of speed limiter usage is detail listed in Table 3 and Figure 7. Efficiency improvement is indicated that it effectively to reduce the speed bus even the driver speedup or uncontrolled the speeding bus. The drivers have to strip off the accelerator if they want the speed back to normal and they can push the accelerator back again. The speed report data day by day after install speed limiter become more controlling, it's based on a GPS report in bus id HT.002, HT 006, HT 634, HT 674 and HT 691 the highest speed of the bus is 124 km/h when the bus on rushing with average speed is 99 km/h, Base on that table's data, speed limiter can control until 98% speed of the bus in highway or urban street.

**Table 3.** Improved use of speed limits

No	ID Vehicle	Type Vehicle	Average speed before installed speed limiter (km/h)	Average speed before installed speed limiter (km/h)	Average speed after installed speed limiter (km/h)	The average speed after installed speed limiter (km/h)	Improvement (%)
1	HT 002	Bus	110	110	86	24	78%
2	HT 006	Bus	101	101	87	13	87%
3	HT 634	Bus	87	87	85	2	98%
4	HT 674	Bus	99	99	87	13	87%
5	HT 691	Bus	124	124	88	35	71%



**Fig. 7.** Improvement use of speed limiter.

## 5 Conclusion

The embracing of the paper is speed limiter can be an effective appliance way for a transportation company, especially for protecting their bus machine, their human resource and their environmental. When the bus on rushing in the highway or urban way, the driver potentially speed up the bus. It can be seen on GPS tracking data before installing speed limiter, the highest speed of 136 km/h on the highway and 99 km/h in urban street. After speed limiter installs on the bus machine, the speed reduces significantly. Based on the data summary of GPS tracking, while the bus rushing on the highway become 88 to 90 km/h and on the urban street become 70 km/h. The improvement percentage of speed limiter appliance until 83 % and it is prospecting for reduce speed of the bus. It approved that this speed limiter is most recommended to apply in public bus transportation. It will potential to reduce the accident rate and reduce the victims.

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## References

1. *Rencana Umum Nasional Keselamatan (RUNK)*, (Republic of Indonesia: Technical Report, 2011)
2. E.M. Ossiander, P. Cummings, *Accid. Anal. Prev.*, **34**, 13 (2002)
3. M.M. Gallagher, C.M. Sewell, S. Flint, J.L. Herndon, H. Graff, J. Fenner, H.F. Hull, *Journal of American Medical Association*, **262**, 2243 (1989)
4. D.B. Brown, S. Maghsoodloo, M.E. McCardle, *J. Safety Res.*, **21**, 125 (1990)
5. A.J. McKnight, T.M. Klein, *Transport Results Records*, **1281**, 71 (1990)
6. C. Lave, P. Elias, *Accid. Anal. Prev.*, **26**, 49 (1994)
7. United States. Federal Motor Carrier Safety Administration. *Future Truck and Bus Safety Research Opportunities*, **38**, (2006)
8. B. S. Dhillon, *Safety and Human Error in Engineering Systems* (CRC Press, 2012)
9. Constitution Number 22, clause 203, Republic of Indonesia (2009)
10. Regulation Manistry of environment (KLH), **74** (1999)
11. Regulation Manistry of transportation, Republic of Indonesia, *Procedures for Determining Vehicle Speed Limit*, **111**, (2015)
12. Policy as expressed in an internal memo No. 154/F00010/2013-S0 on 8 April 2013 than stated on HHSE Guidance, PT. Pertamina Persero (2013)