A Study on the Methology of Increasing Safety for Cometto MSPE System

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Abstract. In recent years, the heavy transport industry has been developing strongly, the transportation of super long and overweight packages is more advantageous due to modern transportation systems applying the achievements and development of technology. The leading trailer manufactors in the world such as: Cometto, Nicolas, Kamag, and Goldhofer… increasingly research and manufacture for this heavy transport industry. In Vietnam, leading transport companies have invested in self-propelled tractors from Cometto (Italy) to transport these goods. However, during operation, safety has been revealed. Therefore, in order to further enhance the safety of the entire system when transporting large economic parcels to the required location, a method is proposed that the throttle valve have been attached to appropriate position in the hydraulic pump system. The efficiency of throttle assembly is verified in practice when applying this improved trailer system for transporting the drilling rigs up to 3,200 tons in Vietnam.

Keywords: MSPE · Heavy transport · Self-propelled trailers · Hydraulic system

1 Introduction

Recently, the transport of oversized and overweight packages with high safety requirements for people and the cargo is extremely important to businesses in the heavy transport industry. The road surface is the most common object to be damaged during the transportation of these special packages. Therefore, many methods proposed as solutions to solve this road surface problem in [1, 2]. The oversized and overweight packages such as: 1) Oil rig components need to be transported from the installation location to the Barge and then pulled to the sea for completion; 2) Transformers from several dozen tons to nearly 300 tons need to be transported to power stations; 3) Concrete beam girders that need to be transported into a common site are transported using large-capacity tractors to push or pull cargo trailers, which is called the towing method and illustrated in Fig. 1.

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Fig. 1. The use of high-powered tractors to push or pull convoys of cargo trailers

In order to overcome the disadvantages caused by the towing method such as: 1) The tractor speed is asynchronous; 2) The tractor steering centers are different, making it difficult to control; modern self-propelled trailer with many special functions is used instead of tractors as illustrated in Fig. 2.

Fig. 2. A modern self-propelled trailers transporting oil-shore

When the system is utilized, the obtained advantages are as follows:

- Because the system requires only one operator to operate via remote control, the trailer speed is highly synchronous.
- The trailer steering center is unique.

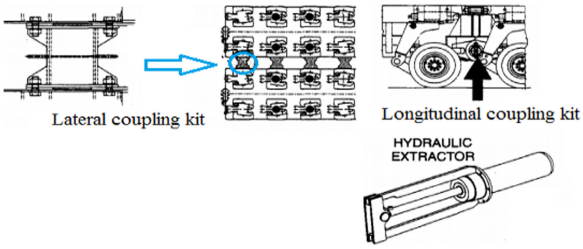
The navigation for the system normally employs GPS algorithm, IMU algorithm [3], vision algorithm [4] and combination techniques of the above algorithms [5].

Transporting oversized and overweight packages by self-propelled trailer has been very popular around the world. However, very few companies in Vietnam use this method due to high investment costs. Even so, Vietranstimex put money into an Italian

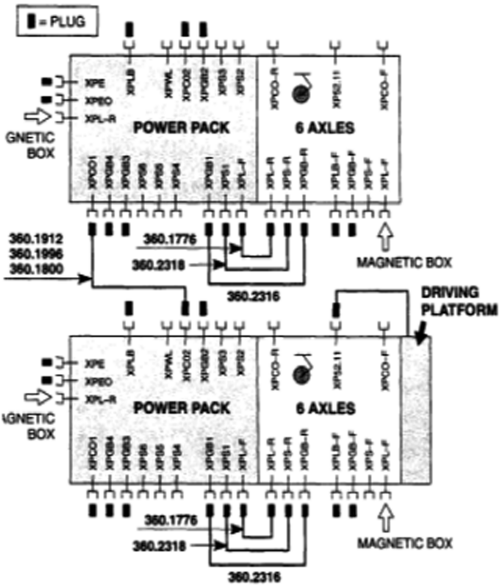
self-propelled trailer system named Cometto [6] in a Modular Self-Propelled Electric (MSPE) type. The Cometto system outstanding features can be listed such as:

- The vertical and horizontal couplings connect the modules together according to the size and load of the package. This is a flexible feature of the system.
- The ability to rotate the package in place 360° of the steering system.
- The system's steering center can be changed easily to respond to difficult off-road situations.

During the operation of the Cometto MSPE, the most common problem is that the electronic load cell (ELS) valve is often damaged or faulty. In order to overcome the problem, a novel solution that a throttle valve N is inserted between tap J and ELS valve was proposed. After the throttle valve N was installed, the MSPE system worked very stably. The proposed MSPE system was utilized in order to safely transport and launch a lot of oversized and overweight packages.



(a) Mechanical connection



(b) Electrical-electronic connection

Fig. 3. Main system components of Cometto MSPE.

The remainder of this paper is structured as follows: the basic Cometto MSPE is described and the proposed method is in Sect. 2; Sect. 3 shows results via projects that apply the proposed method and the paper is concluded in Sect. 4.

2 The Proposed Method for the Cometto MSPE

2.1 The Basic Cometto MSPE

The main system components (as illustrated in Fig. 3) consist of Power Pack Unit (PPU); The 4/4/3 MSPE and The 6/4/3 MSPE. The PPUs and modules are utilized according to the package weight and size.

2.1.1 The Power Pack Unit

The PPU (as depicted in Fig. 4) is considered to be a key component of a MSPE. It consists of an electronic control system [8] and a hydraulic system.

Fig. 4. Cometto power pack unit

Pumps are used in the hydraulic system has parameters as listed in Table 1.

Table 1. The pumps in the hydraulic system

Variable displacement pumps	
Lifting and steering pump	A11VLO190
2 motorization pumps	A4VG180 + A4VG125

2.1.2 Modules

The parameters of modules such as 6-axis type (6/4/3) and 4-axis type (4/4/3) with a maximum load for one axle of 34 tons are listed as in Table 2. Modules are connected by 3 connection types of mechanic, hydraulic and electronic. The connections are configured in back to back coupling (serial configuration) and side by side coupling (parallel configuration) as depicted in Fig. 5.

Table 2. Module parameters

Weights	MSPE 4/4/3 (4 axles)	MSPE 6/4/3 (6 axles)
Speed (km/h)	0.5 5 10	0.5 5 10
Axle load (2 suspensions), ton	34 34 31	34 34 31
Total gross weight, ton	136 136 124	204 204 186
Dead weight, ton	1.77	26
Payload, ton	186.3 186.3 106.3	178 178 160
AXLES		
Axle lines quantity	4 (8 suspensions)	6 (12 suspensions)
Driven axles quantity	2	4
Braked axles with A.S.R. quantity	2	2

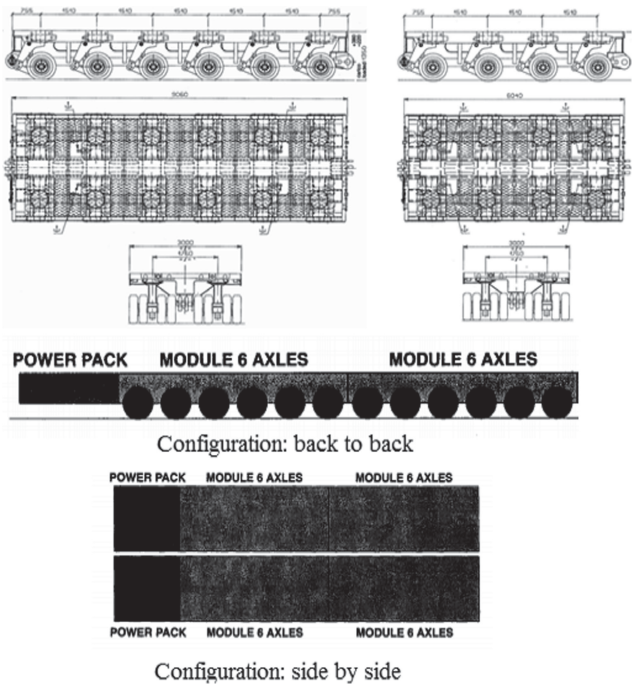
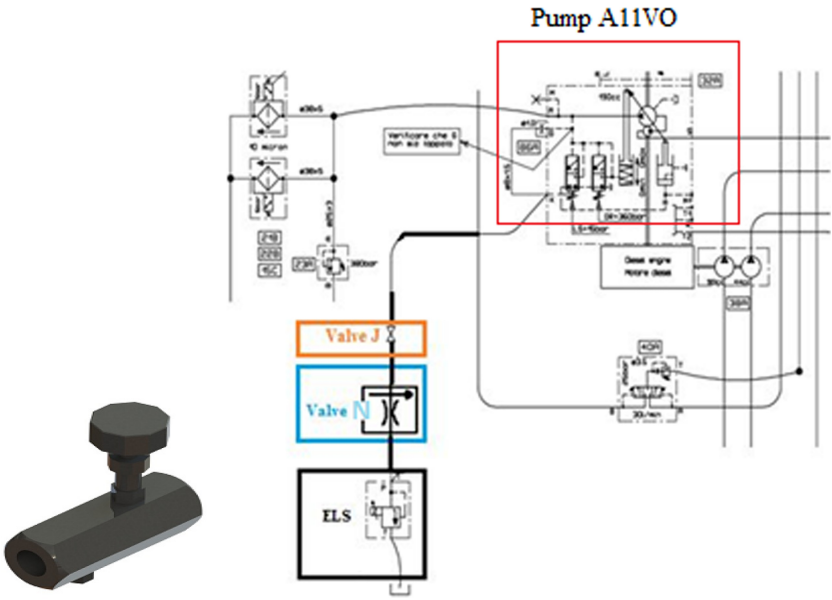


Fig. 5. Module configurartion

2.2 The Proposed Method

The functions of hydraulic steering and lifting/lowering which are described in [9] are supplied by the pump A11VO. This type of pump is used due to the hydraulic oil flow automatically changes when the load changes. The function working pressure is adjusted by the proportional valve ELS.

In this section, we propose method of putting a new throttle valve N [7] (as in Fig. 6-a) at position between valve ELS and tap J. The valve N is used to temporarily replace the valve ELS when it is suddenly damaged or failed as illustrated in Fig. 6-b.



(a) The throttle valve N **(b)** Proposed position of the throttle valve N

Fig. 6. The proposed hydraulic pump system

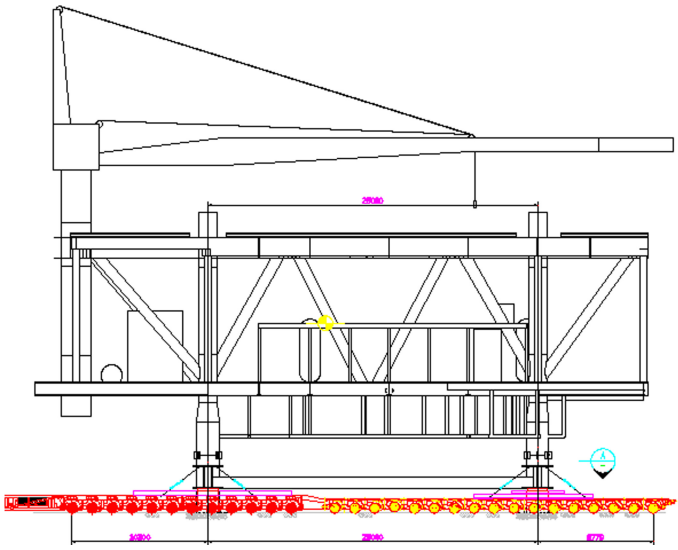


Fig. 7. Hai Thach 1 project topside

The valve ELS is controlled by the electronic system as follows:

- When the diesel engine is started, the pressure reaches 15 bar immediately. The engine speeds up to 900 rpm after 5 s. At this moment, the pressure will reach 220 bar.
- When the steering and lifting/lowering are adjusted, the pressure fluctuates around 220 bar and peaks at 300 bar.
- Brake pressure maintain from 170 bar to 220 bar.

The system pressure drops down when the ELS valve are damaged or failure. At this moment, tap J must be closed in order to forcefully increase the system pressure up to 360 bar.

Malfunction of the ELS valve is very dangerous for the whole system because it determines all the functions of lifting, lowering, steering and braking when operating a Cometto MSPE. However, closing tap J jeopardizes the A11VO pump as it must work at full power to push the piping system pressure up to 360 bar. Therefore, the tap J cannot be closed for a long time. Practical experience shows that ELS valves often catch fire when working because the suction coil of ELS valves is always electrically soaked and the temperature in Vietnam is hotter than Europe; especially in Cometto factory in Italy.

In the case if the tap J and the ELS valve are damaged or failure at the same time (case called as valve leak), all functions including lifting/lowering, steering and braking will stop working and uncontrollable. This causes the packages flipped because it is off-center. This damaged case is very dangerous; especially, when the package is located both on the jetty and the barge and the tides are fast rising/falling. Therefore, this damaged case cannot happen. However, if this damaged case happens, an immediate corrective action is required.

The proposed action method is to add throttle valve N between tap J and valve ELS and this is the fastest solution. By turning only the throttle valve N when the ELS valve is damaged or failure, the system pressure (shown on the steering pressure gauge) will reach to 200 bar or to 220 bar. The system works stably because of those pressures. The throttle valve N continues to be adjusted if higher pressure is needed.

3 The Evaluation of Proposed Method

The MSPE system works very stable and safe after putting the throttle valve N at the connection between tap J and valve ELS. Therefore, a lot of petroleum packages are relocated safely and effectively. The key project named as Bien Dong 1 – Hai Thach 1 had been applied the proposed method is desribed in details as following (Fig. 8):

Topside Project (as shown in Fig. 6):

- Topside: 3,200 Ton
- Wide of topside : 35 m
- Long of Topside : 45 m
- High of Topside: 40 met
- Client: PTSC/Bien Dong POC

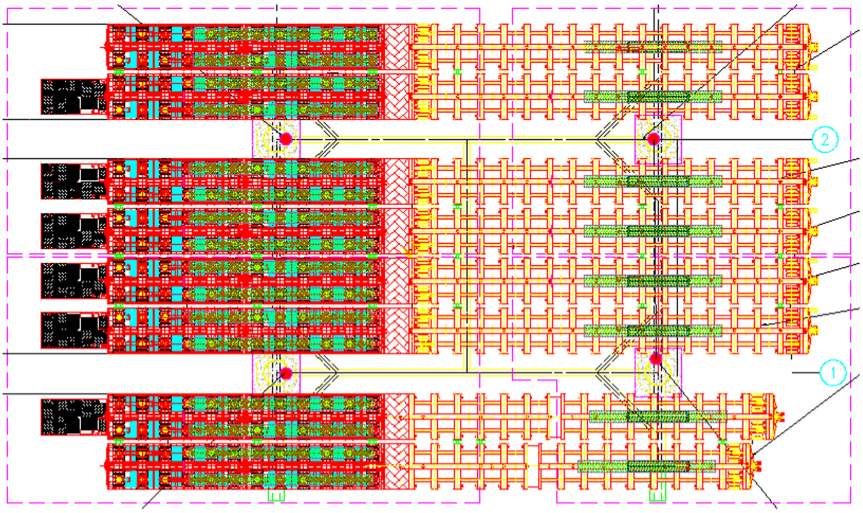


Fig. 8. Configuration of trailers for Hai Thach 1 project

- Location: PTSC Port, Vung tau, S.R.Viet Nam.
- Duration: 2012.

Each trailer is configured as follows: 6 PPU and 227 axles (as shown in Fig. 7).

In this project, the proposed MPSE system is tasked to relocate the 3,200-ton upper block of Hai Thach 1 a distance of 500 m and then to launch it to barges.

During operation, the ELS valve failure occurs when the trailer is relocating packages across the bridge between the jetty and the barge. The working pressure drops to almost 0 bar immediately and the system stops working. All functions of steering, lifting and braking are totally uncontrollable. At this moment, the throttle M is installed at the proposed position and the technician adjusts the throttle valve N so that the steering pressure and the lift/lower pressure rise again, up to 220 bar. It takes less than 1 min to install the throttle valve N compared with 30 min spending when acting to replace the faulty ELS valve by the good one.

In addition to the aforementioned typical project, other projects (as listed in [10]) applied the proposed method. Therefore, our Vietranstimex Company has become the leading company in Southeast Asia and the 34th rank in the world in the oversized and overweight transportation.

4 Conclusion

Because the valve ELS very often happens failures during the actual operation of the trailer system. Furthermore, in the inevitable damage caused by a faulty valve, safety comes first. Thanks to the proposal of installing throttle valve N at the connection between valve J and valve ELS, it increases the safety of the operator and the trailer system; at the same time, increasing the mobility of the transport equipment and

significantly reducing trailers troubleshooting time in cargo as well. This alternative proposed method has been applied in practice to many projects of transporting oversized and overweight packages in Vietnam from 2012 to 2020. The great results obtained by the proposed method are the best evidence for the efficiency.

However, because throttle valve N only operates manually and the ELS valve opens and closes automatically through electronic card control in the PPU, it is not possible to completely replace the ELS valve by the throttle valve N. Therefore, the replacement of the faulty ELS valve by the throttle valve N is only temporary and the faulty ELS valve needs to be replaced by a good one as soon as the unloading of packages is completed.

In addition to Cometto, each company that produces MSPE system such as Goldhofer, Nicolas and Kamag has different strengths, but all of them are for absolute safety for operators and goods by applying technology to enhance advanced performance.

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Conflict of Interest. The authors declare no conflict of interest.

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