IDENTIFICATION OF SUITABLE ONBOARD PARKING SPACES
Work Package 3.3

ALBERO Project

Institut für Sicherheitstechnik/Schiffssicherheit e.V.

AP 3.3 Identification of suitable onboard parking spaces

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In the course of the project three options for a parking concept appeared.

1. Determination of defined parking spaces

Within this concept a precise designation of suitable parking spaces is done on each vessel for each type of drive. The previous research of the ISV at ALBERO showed that the determination of such specific parking spaces depends on several factors, including:

- structure of the specific ship (number of closed, semi-open decks, extent of open deck areas, etc.)
- specific traffic volume in each case, e.g. transport of dangerous goods,
- size of the alternatively powered vehicles and thus the space occupied (car, truck, coach, ...).

The definition of **general requirements** for parking spaces that apply in general is therefore only possible in very rough terms, since ships are very different and the vehicle situation changes with each departure. Thus

- electric cars should, if possible, be located on a deck above the waterline to allow the flow of large amount of firefighting water in the event of a fire.
- electric cars should, if possible, have a greater distance to other vehicles (min. 0.6 m) and should be parked in such areas where they are not surrounded by other vehicles at all sides if possible (at the beginning, at the end, at the side)
- gas-powered cars should be located on an open deck area or on a semi-open deck, if possible. Here, however, competitive or dangerous situations may arise due to hazardous goods transports, which may also only be transported in such areas.
- good ventilation, natural or artificial, should be possible

A parking space concept derived from this is shown in Figure 1.

Advantages:

- the specific designated parking spaces can be equipped with adapted detection, safety and extinguishing technology for the respective types of drive. By defining small areas, the costs for this are manageable. The probability of early detection of a hazardous situation and deployment of the most appropriate measures is relatively high.
- can be implemented most quickly with the technology currently available

Disadvantages:

- a pre-sorting in the port area or a labelling is necessary in order to direct the cars to the respective parking spaces when they drive onto the ferry.
- it can be assumed that the number of existing designated parking spaces only in the rarest of cases corresponds exactly with the amount of cars and the respective type of drive. For example, 3 parking spaces have been designated for electric vehicles, but 6 want to come. Or no electric car arrives, in which case one would still not want to leave these three parking spaces empty and place other vehicles there. Therefore, the ship's management cannot assume that the designated parking spaces are actually occupied by the correct number of

cars, nor can assume that no cars of the respective type of drive are transported outside these spaces.

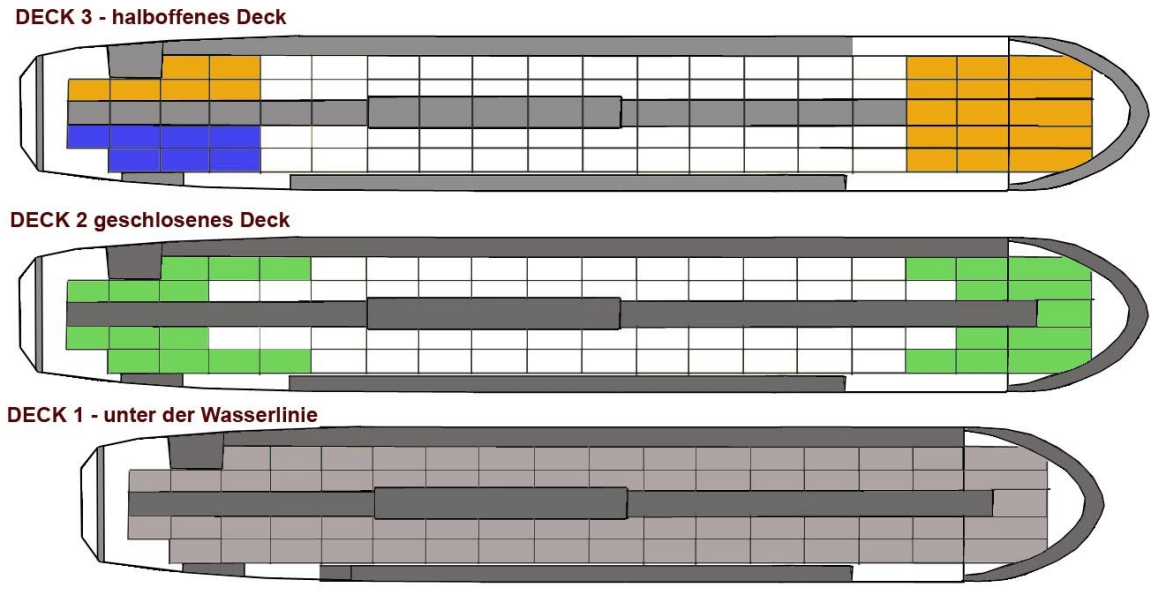

Figure 1: Parking concept according to the above basic premises, yellow - gas-powered vehicles, blue - hydrogen-powered vehicles, green - electric vehicles, gray - conventional vehicles.

2. Determination of defined areas

Within this concept, only rough areas are determined where the different types of drive will be transported. These areas must also be determined on a ship-specific basis. For example, it is specified that all gas-powered cars go to the semi-open deck, without making any more specific determinations about the location on this deck. Otherwise, the general requirements, already defined under option 1, should be considered.

Advantages:

- the defined areas can be equipped with adapted detection, security and fire fighting technology
- possible with the currently available technology
- in the event of an accident, the ship's command would know exactly that, for example, in the event of a fire on the semi-open deck, that gas-powered vehicles should be expected there, but in the event of a fire on the closed deck, gas-powered vehicles will not be present, since all gas-powered vehicles are always directed to the semi-open deck

Disadvantages:

- A pre-sorting or labelling in the port area is necessary to direct the vehicles to the respective areas when they board the ferry
- the development and installation of a functioning detection and fire-fighting technology is more difficult, since other (conventional) vehicles may be present in addition to vehicles of the respective type of drive. The adapted detection and fire-fighting technology also has to cover a larger area, this can mean on the one hand that more sensor technology has to be

installed (increased cost factor) and on the other hand that the accuracy of the alarming or fighting the thread decreases because too many disturbance variables occur.

3. Flexible parking space with local real time display

Within this concept it is assumed that the type of drive is determined only when the car boards the ferry or the car is positioned onboard. This can be done by:

- fast recognition by the onboard instructor, e.g. if a clear and fast recognizable identification of a alternatively powered vehicle is agreed in the near future (e.g. colored license plates)
- scanning of license plates and prompt license plate query at the German Kraftfahrtbundesamt (Federal Motor Transport Authority)
- scanning of the vehicle with various sensors and camera technology - intelligent (image analysis) software recognizes the vehicle type and thus also the type of drive

Supported by a software, the distribution of cars on the car decks (e.g., by different colors for the different types of drive) is quickly displayed in near-real time on a departure-by-departure basis (see figure 2 below).

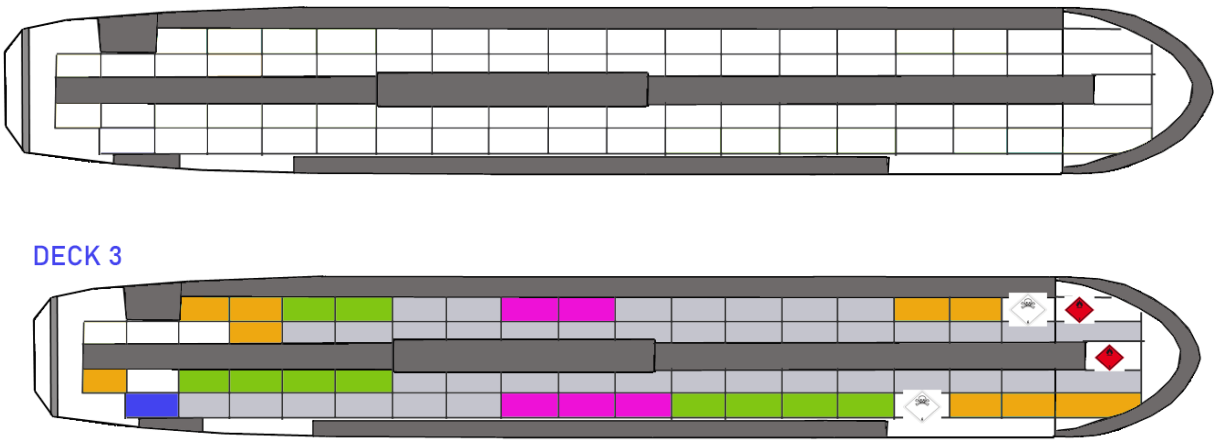

Figure 2: Representation of the current loading status for a deck as an example, top: tablet image (and bridge display) before loading, bottom: tablet image (and bridge display) after loading (grey - conventional, yellow - gas, green - electric, blue - hydrogen, pink - refrigerated truck as well as hazardous goods)

Depending on the detection described above, this loading image is created by the onboard instructor(s) during loading (e.g. by "color tipping by fingertip on a table") or the image creates itself by an interface with the scanning technology/detection sensor technology).

With this parking space option, the early detection systems must either be installed everywhere or be mobile and, if necessary, depending on the loading pattern, move independently towards the respective type of car, i.e. (see also detection concepts by J. Kelleter, GTE):

a) All parking spaces are monitored by (many) permanently installed gas/heat/.../sensors; if necessary, the sensors know the **loading pattern** and react specifically to it accordingly

b) There are different sensor arrays on board, each of which is particularly suitable for one type of car. Depending on the **loading pattern**, these sensors move to the most appropriate position (e.g., travel along a track).
c) A mobile drone drives along the car tracks. It may know the **loading pattern** and therefore know what conditions are normal or abnormal for the particular type of car in the parking space (e.g., underbody thermography images). This would possibly minimize false alarms.

In any case, the sensors can give location-resolving alarm. By coupling with the loading pattern, each alarm is immediately specified as a gas alarm, hazardous material alarm, electric car alarm. A question arises cobnerning the interface between sensor technology and parking space distribution. Perhaps the exchange should not only go in one direction, e.g. the sensors give an alarm indication on the parking space display, but the sensors also know the parking space allocation?

The hazard prevention systems/fire extinguishing systems are also mobile within this concept, e.g.

- use of mobile partition walls or non-combustible tarpaulins on the car decks with which (electric) cars can be separated/covered.
- use of mobile water spray system on board that can be pushed under (electric) cars so that the vehicle is also sprayed with water from below.

Advantages:

- a pre-sorting is not necessary
- The loading is quickly and as needed. All cars can be placed where they fit best. Nevertheless, it is known exactly where each type of car is at any given departure. Even in the event of an alarm, there is an immediate overview of the overall situation.
- all cars are monitored, ideally specifically with regard to the dangers they pose

Disadvantages:

- a fast recognition of unmarked vehicle type is not technically implemented yet → not feasible within the project
- an EU-wide agreement on fast visible identification is not to be expected so soon
- license plate scanning: possibly problems with data protection, international different
- mobile sensor technology is susceptible to failures
- mobile sensor technology might have to contain a Li-Ion-Battery itself (e.g., mobile drone) and thus poses its own risk
- expensive

Considering the advantages and disadvantages presented above, the implementation of option 2 seems to be the best according to the current status of the project.