Operation of aerial ropeways without present staff

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Introduction / Abstract

The operation of aerial ropeways normally requires the presence of staff on site, so as to enable and monitor their functionment. Classically, at least one operator is physically present in every station, and even in each cabin for some jigback installations.

However, a new operation mode has appeared in France these last years on some closed-vehicle ropeways, in order to allow operation without physical presence of any operator on-site in some stations. This operating mode can be named “manless operation” or “operation without present staff”, which are translations of the french “exploitation sans opérateur”, often shortened in “ESO” in France.

The acceptance for such an operating mode is based on a specific safety analysis, allowing to identify, since conception phase, constructive measures that allow to reduce many risks in a signifiant way, risks that would be normally treated with instructions for the operators.

The main questions raised in such safety analysis are :

- safety of passengers during their access to the installation and in the waiting zones,
- monitoring of loading and unloading phases,
- management of the embarked weight,
- management of weather conditions,

- management of alarms and automatic stops, along with their resetting,
- fire risk management.

Concretely, this operation mode without present staff has been implemented on several installations in France : jigbacks, funitels and gondola systems.

For all that, ropeway systems shouldn't be considered as elevators or even funiculars, and engineer reasoning must not replace a certain field culture acquired on usual ropeway installations, from which reflexes must be kept, all the more so as all aerial ropeway systems are particularly exposed to climatic conditions.

1) Definition and examples of installations without present staff in France

The type of operation covered here is not totally manless : there are some operators, but not one or more in every station like on usual ropeway installations.

In the last years, this operation mode has been put into operation on several new installations in France, installations either with jigback-like operation or with continuous movement.

- Jigback operation :
  - Funitel « Trois Vallées (Bouquetin) » in Val Thorens – POMA – 2003
  - Gondola « Télébuffette » in Montchavin – Leitner – 2008
  - Funitel « Thorens » in Val Thorens – BMF – 2011
  - Gondola « Petit Moriond » in Courchevel – POMA – 2012
  - Jigback cable car « Dahu » in les Arcs – BMF – 2015
  - Jigback cable car in Brest – BMF – 2016
  - *Jigback cable car project in Orléans – POMA – 2018*
- Continuous movement operation :
  - Gondola « Cairn-Caron » in Val Thorens – Doppelmayr – 2007
  - *Gondola project « Moraine » in Val Thorens – Doppelmayr – 2017*

Depending on what the ski resorts or cities specified for the manufacturers, and depending on the automation level needed, the remaining operators can be positioned in various places :

- only one operator in one station, for several stations on the installation (ex : Cairn-Caron, Trois Vallées – Bouquetin),

- operator positioned and already supervising another installation, for example a chairlift near the semi-automatic jigback / gondola (ex : Thorens, Moraine project),
- operator in a remote control room (ex : Dahu, Brest, Orléans project), sometimes already monitoring other systems (ex : public transportation like tramway system in cities),
- choice sometimes possible between these options (Télébuffette, Petit Moriond).

Thus, the main focus is to keep the same safety level without any operator on-site as with one or more. But before seeing the associated subjects, we will focus shortly on regulations.

2) Regulations for installations without present staff

This type of operation is not directly treated or mentionned explicitly in the EN european standards.

In France, there have been some changes in 2016 on the ropeway regulations (*arrêté du 7 août 2009* relative to conception, realization, modification, operation and maintenance of aerial ropeway systems, and STRMTG guides RM1-RM2), among other things so as to take more into account the specificites of urban ropeway projects and make an update along some european standards that had evolved.

Whereas before, a cabin staff was mandatory, it is now allowed to operate an installation with more than 40 people in a cabin without on-board staff, as long as there are double-way communication systems between passengers and a remote operator. This is particularly interesting for urban uses, but also possibly for some ski resorts.

Before, the texts referred explicitly to the installation driver, whereas in the new version, it is replaced by references to driving missions, to account for all cases. This is linked with the recent implementation and enforcement of safety management systems on ropeway installations in France (see Gaëtan Rioult's presentation on the subject in the same OITAF congress).

Apart from these points, even in the french regulation, there is no particular mention of how an operation without present staff should be handled. However, french control authorities always ask for a special safety analysis to ensure that the safety level stays equivalent to an usual installation.

3) Main focus points and discussions

The main subjects that we want to see addressed in the specific safety analysis are detailed in link with the previous installation examples in France.

3-1) Passenger safety in stations in link with the ropeway

The station must be designed so that passengers can not enter in contact with any mechanical part that could hurt them (mainly moving mechanical parts).

As we can see on these photos, in "Jean Moulin" station of the jigback in Brest, mechanical parts are quite high and unreachable, and in addition to platform screen doors (opened on the photo only because we were performing tests), there is a glass roof enabling additionnal protection.

An annex subject, not related directly to "normal" safety, is that designers of such systems should also take into account possible bad behaviors of people trying to access forbidden zones, especially for city uses.

3-2) Passenger / cabin interface

This problematic is quite close to the passenger/train interface on an automatic underground railway system. The main risks linked to this interface are : passenger falling from the platform, going under a cabin, stuck in the doors while the cabin is departing.

The most obvious solution is to use platform screen doors (PSDs), preventing falls from the platform, shocks with cabins, and departure while a passenger may be stuck in the cabin doors (ex : jigback system in Brest and jigback project in Orléans).

When such a system can not be used (for example for continuous movement installation, for which it is complicated to handle cabins stopping to load passengers), or is judged too costly, alternative ways can be used to cover these risks, often based on immaterial detection of passengers in "risk zones" (mostly under the platform, in the zone of the cabin door to detect the presence of people).

On these photos from the top station of jigback-operated Funitel Trois Vallées (ex-Bouquetin), we can see such presence detectors in the pit and on the edge of the platform.

Another solution was used for continuous movement gondola Cairn-Caron (still in Val Thorens), with a “moving cabin wall” in unmanned stations. There are some specific parts added on the cabin sides so as to prevent a fall between cabins. Some chain claws up in the station tracks allow to manage the space between cabins, and guides are added in the upper part to for a good equilibration of the cabin. Physical screens prevent people from going further outside cabins ; sensible platforms have also been put next to these screens so as to stop the installation in case of a bad loading/unloading.

New technical solutions are currently being developed for the 2017 gondola project “Moraine”, again in Val Thorens.

On all these systems, with or without PSDs, with continuous movement or jigback-like, alarm and/or stopping buttons are accessible to passengers on the platforms. Discussions can be complex about what they should do (stop immediately or stop in normal position or just send an alarm ? does the system allow to unlock some doors ?), depending on the cabin position (exiting or entering the station, on the line), again in a similar way as on a fully-automatic underground railway.

3-3) Embarked weight management

This subject is important so as to respect the conditions of use of the cabins (and indirectly the rest of the installation), related to their fatigue calculation : if there are too many people in some cabins, they may get more fatigue damage than taken into account in calculation hypothesis.

Example of many people loading at jigback-like Funitel Thorens

As nobody on-site can count the number of loaded passengers on-site or control people going over counting barriers on jigback systems, there is a need for :

- a physical limitation inside the cabins,
- and/or an integrated control system, preventing departure in case of overweight (such a system if often already used by the manufacturer for big cabins, in order to calculate the cabin with 3500N/m²).

3-4) Management of weather conditions

Compared to an usual installation, the operator may not see directly and not « feel » the conditions in every station.

So wind sensors, their position and their treatment are particularly important, possibly with intermediate alarms before stopping the installation. The importance of checking weather forecast / reports daily before operation is increased, in order to know what likely conditions to expect. The daily morning visit before operation is also critical to evaluate the system state before operating, for example if it snowed or if there was wind the night before.

On such installations, video cameras are often used in stations and sometimes on the line, so that the operator may see what happens, but they have no safety level, can be out of order without the installation necessarily stopped, and can be of little help when weather conditions are too bad.

Example of snow/wind at the top of jigback-like Funitel Trois Vallées (ex-Bouquetin), an installation specially designed to operate with huge winds to enable returns to other linked resorts

3-5) Management of alarms / automatic stops

By conception of the system, only few alarms are resettable remotely, but most are not : for the most critical and the ones in close link with field conditions or mechanical parts, an operator is necessary on site to make a visual control before enabling the installation to run again. In such cases, a limited delay for an operator to access the installation must be defined from the conception phase, so as not to leave passengers stopped for too long, and the operation must be organized to take this delay into account.

Several subjects need to be discussed, specifically for each project, examples are :

- should passenger alarms triggered on platforms resettable remotely ? (this is also a classic subject on automated underground railway systems)
- should the system stop or not, depending on cabin position ?
- in case of an automatic stop due to a short and sudden gust of wind, from where could you enable the installation to run again, and at which speed ?

3-6) Evacuation

The evacuation process is also closely linked with the previous subject. Depending on the options chosen to stop the cabins and allow the unlocking of the doors, there can be situations allowing passengers to auto-evacuate close from the station.

These two photos have been taken in “Capucins” station of the jigback in Brest. On the first one, taken from inside the cabin, we can see a situation where the cabin is not stopped in its normal position, but it is still possible to unlock and open both cabin and PSD doors and to evacuate. On the second photo, taken from the platform, we see another position enabling passengers to auto-evacuate, but with more height. In order to enable these evacuation situations, tests must be done, and specific risks must be prevented : in this case, we see a gap under the cabin in which a passenger might manage to fall, therefore a protection net has been added under the cabin. Lateral gaps between cabin and PSD doors must also be reduced as much as possible.

3-7) Fire risk management

In the updated french regulation, a specific fire analysis is mandatory for every new installation (but the “usual” mountain rules are accepted as an adequate analysis). This is all the more important for installations without present staff, as the early detection of a fire relies on other means, especially near stations (automatic detection, passenger alarms, …). In fire situations, the communication system between the remote operator and passengers, both ways, is very important, all the more so as the operator is located far from the system.

Another question raised is how to trigger the “fire emergency mode” introduced in the future fire prevention european EN standard, enabling the installation to run at full speed without any active safety devices, considering that the fire risk is bigger than any risk linked to the system itself. Should this mode be triggered remotely, which can be considered dangerous with no one on site to check what can happen, or should it be triggered only on site, but with a delay for someone to arrive there, so with a higher risk that the fire may develop ?

4) STRMTG feedback on such systems and conclusion

In France, with soon ten aerial ropeway installations without present staff in every station, no serious incident has been reported so far on such installations directly linked to this operation mode. STRMTG got rather good feedback from compagnies operating them, and there don't seem to be many occurrences of operators compelled to access to the unattended installation stations to solve problems. However, more minor incidents and the complex focus points seen during the instruction tend to comfort STRMTG in its vigilance on such systems.

However complex these points may be, the specific safety analysis still guarantees that the safety level for such an installation is at least as good as a more usual installation with staff in every station.

On financial considerations, project managers should not forget the extra cost in conception studies and on extra safety systems and their maintenance, that can be compared to saved salaries of operators.

Usual reflexes and uses from usual ropeways must absolutely be kept or acquired, to manage weather conditions, but also to manage alarms and their resetting : for example, on a jigback, to handle a safety function failure such as a discordance, when identified as such, this function should be shunted and the system re-launched at limited speed with human monitoring, and only then when cabins are back in stations, the automats should be allowed to be totally reset.

An aerial ropeway, manned or unmanned, remains a complicated system and must not be handled as an elevator or an escalator working "on its own". This is especially true in cities where operating entities often don't have prior experience in operating ropeways. In cities, these systems should rather be considered in the same way as fully-automated underground railway systems, which are complex and require constant attention.

In conclusion, such systems work quite well so far in France, and have certain advantages, but the operation without staff should remain a special operation mode that it should be possible to give up at any moment.