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Immersive show with Ocean Express

Ocean Park Chief Executive Mr Tom Mehrmann during the ISR interview on the Ocean Express, the world's first and only themed 1,300 m funicular system that operates in a tunnel within a theme park and with an immersive show experience.

ISR: What made you decide to build the Ocean Park funicular?

T. Mehrmann: Ocean Park is embarking on a massive US\$ 750 million redevelopment called the Ocean Park Master Redevelopment Project (MRP). The project started in 2006 and will be completed in 2012/13, doubling the Park's attractions from the existing 35 to over 70.

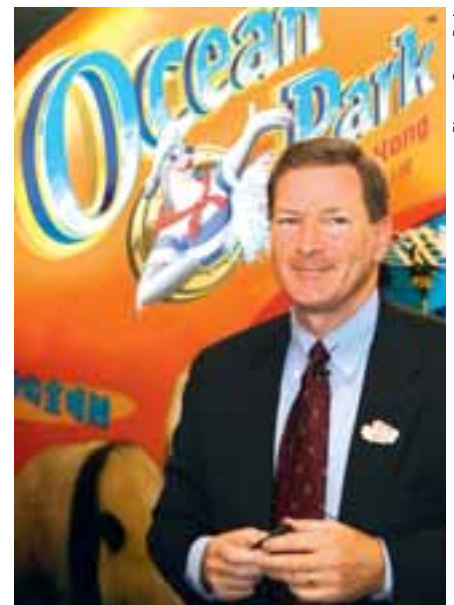
According to conservative estimates, the annual attendance at Ocean Park will increase from approximately five million now to seven million people in conjunction with the increase in entertainment capacity.

Ocean Park is built on challenging terrain with different areas separated by a hill. Currently, the lowland area of Ocean Park is connected to the headland area by two aerial cable car lines, which run along the coast, with Brick Hill on one side and the majestic South China Sea on the other. The capacity of the two

cable lines is no longer adequate during peak periods, and with a projected attendance of seven million, new means to supplement the cable car service must be found. After studying many feasibility models, it was found that building a funicular system in a tunnel within Brick Hill is not only NOT far-fetched, but definitely workable. The construction of a funicular system inside Brick Hill was accordingly integrated in the MRP. The rest is history, while Ocean Park creates another historic moment!

Here are some "fun" facts about Ocean Park's new funicular system. It is called Ocean Express, and the two stations will be called Waterfront Station (for the lowland area) and Summit Station (for the headland area.)

■ Ocean Express is built in a 1.3 km tunnel running beneath Brick Hill, parallel to the Park's 32-year old cable car, which in itself is a key tourist icon and the favourite attraction for Ocean Park guests.



Photos: Ocean Park

Ocean Park Chief Executive, Mr Tom Mehrmann

- Ocean Express will be the world's first and only "undersea odyssey" themed funicular system operating in a tunnel within a theme park.
- Upon completion, Ocean Park will be the only theme park – and place – in the world with three ropeway systems running almost side by side: two aerial cable car lines and the Ocean Express underground funicular.



- Ocean Express will carry visitors between the two central points in Ocean Park, Waterfront and Summit, in just three minutes. (The regular cable car ride is 8 to 10 minutes, depending on wind conditions.)
- The system will have two trainsets running in each direction, with a maximum carrying capacity of 5,000 guests per hour in each direction.
- The new funicular will play a key role in providing visitors with a more efficient transportation facility.

ISR: What has been done to make the new installation a special attraction for visitors to Ocean Park?

T. Mehrmann: Ocean Express is the only funicular system in the world built specifically for theme park applications. It is not merely a highly efficient mode of in-park transport to whisk the Park's five to seven million guests a year between the different areas, but it will also be a totally unique, immersive and submersive experience – because the rides will offer two different (one for uphill, and another for the reverse direction) multi-sensory, multi-media “undersea odyssey” adventure experiences. The trains are designed to look like a 19th century explorer's submarine. Inside, multimedia effects give passengers an out-of-this-world sensation as they traverse the deep, deep sea. The two stations and the waiting areas are themed in the same era and ambience, but with a wickedly cyber twist, to create eager anticipation and constant surprises for visitors as they wait to embark on a mystery tour

ISR: How high is the capital layout for the funicular and buildings?

T. Mehrmann: We do not talk about costs for individual projects. But the Master Redevelopment Project is a HK\$ 5.55 billion (US\$ 750 million) undertaking, and the Ocean Express funicular system is part of this MRP.



Ocean Express Waterfront Station (i.e. at the current Lowland)



The Ocean Express in the station



CEO Dr. Allan Zeman proudly presenting the new Ocean Express from inside



A “submarine” for Hong Kong

The funicular built by Garaventa for Ocean Park in Hong Kong has cars in the submarine look.

Hong Kong’s Ocean Park is a theme park and oceanarium that has attracted millions of visitors over the last thirty years. It is comprised of two separate areas called Waterfront and Summit, which so far have been linked by two gondola ropeways.

As part of a major redevelopment scheme for the park, a third link has now been added in the form of a modern funicular built by Garaventa called the Ocean Express.

For visitors to the park, the new funicular is more than a fast and modern means of transportation; it is an attraction in its own right,

one that prepares visitors during the ride for the park theme they are about to experience. With a design capacity of 5000 P/h, the new funicular offers a big increase in the park’s internal transportation capacity and as such is a key element in the overall park redevelopment concept.

The Ocean Express is a completely underground installation and has been designed to meet highly demanding requirements in terms of availability. With the exception of the passing loop in the middle, the line of the funicular is completely straight and has a

constant gradient, which is low enough for the system to operate with a counter rope with hydraulic tensioning in the lower terminal.

As this is an underground funicular, the greatest importance was attached to fire safety. For example, it has been built with a lateral escape tunnel where air overpressure can be generated in the case of a fire to prevent smoke entering the escape route.

The two trainsets are equipped with Garaventa’s tried and tested bogies and have rope drums to attach the haul and counter ropes. As the cars have powerful air-conditioning, continuous conductor rails have been installed to supply the necessary current. The cars are fitted with additional damping on the suspension to minimize the rolling noise produced by the wheels on the tracks and



Photo: Garaventa

Niklaus Moser, Project Manager Sales at Garaventa, provided the following additional information in an interview with ISR



Photo: J. Nejez

to replace an operating bogie during a night shift for servicing requirements.

The order for this innovative funicular was placed by the Ocean Park Corporation in Hong Kong. The work required for the demanding project was handled by Garaventa AG, with Doppelmayr Wolfurt acting as the official contractor.

Shipping the funiculars from the Garaventa plant in Switzerland was a challenge in itself. They were trucked to the Rhine port in Basel and loaded onto a barge to take them to Rotterdam, from where they traveled to Hong Kong by ship. In Hong Kong the cars again had to be loaded onto a boat to take them round the island. Finally, one car per night was transported through the park and placed on the temporary loading rail there.

The new Ocean Express has been designed and engineered in accordance with the Hong Kong Code of Practice, which is based on the old Swiss Funicular Code. In addition, it is in compliance with the local regulations for amusement rides, and the current CEN codes were also applied. The Hong Kong authorities had the final inspections performed by TÜV Süd.

With the Ocean Express, Garaventa has yet another reference installation for funiculars that are comparable with urban light railways in terms of public operating hours and availability. Apart from its function as a modern means of public transport, the Ocean Express also has the typical characteristics of an attractive amusement ride.

TECHNICAL DATA

OCEAN PARK FUNICULAR

Line length	1280 m
Vertical height	115 m
Haul rope diameter	43 mm
Counter rope diameter	26 mm
Drive	upper terminal
Output	550/1500 kW
Trainsets	2 x 2 cars
Car capacity	200 pers.
Line speed	10.0 m/s
Transit time	3.1 min
Design capacity	5000 P/h

thus greatly improve the quality of the ride for passengers.

To ensure that the cars come to a halt in the exact stopping position in the return terminal, the trainsets in the lower terminal come to rest on a hydraulic buffer.

The whole funicular (cars and stations) is in a themed design based on the "Nautilus" in Jules Verne's "20,000 Leagues under the Sea". Passengers have the feeling of departing from a submarine base and diving into the sea. In the cars, this impression is reinforced with the help of a complex audio-visual offering. The car ceilings, for example, are fitted with monitors that show underwater scenes over the full length of the cars, while other optical and acoustic features, including wave lights, a stroboscope and bass loudspeakers, are activated during the ride to emphasize the thematic effect.

In view of the high level of availability required by the operator, a redundant design was selected for the ropeway drive and other key components, and the whole system can be switched to the back-up in the case of a fault. The customer has also been supplied with a reserve car bogie, which can be used

INTERVIEW

ISR: What was the scope of the contract for the Ocean Park funicular?

N. Moser: Garaventa/Doppelmayr were responsible for all the electrical and mechanical ropeway engineering (drive, ropes, cars, control and monitoring systems, terminal and line equipment) and for track construction.

ISR: Can you give us an overview of the time frame for the Ocean Park project, from signing the contract to the acceptance tests?

N. Moser: The milestones were as follows:
Tender submitted: September 2006
Contract awarded: February 2007
Tunnel (holing-through): May 2008
Start of installation work: October 2008
Cars on the track: March 2009
Commissioning: August 2009

ISR: How many employees did Garaventa send to Hong Kong to do what?

N. Moser: Garaventa's Hong Kong team was as follows:
Project Manager Sales: Niklaus Moser
Project Manager Engineering: Andreas Kraushaar (plus three or four employees)
Senior Engineer: Paul Henzen (plus three to five fitters)

ISR: Did Garaventa's know-how with similar projects prove useful for this funicular?

N. Moser: Yes! We were able to make use of the experience gained with several earlier projects, including the Taksim-Kabatas funicular built in Istanbul in 2006, which was a similar project in many ways.

ISR: What were the main challenges presented by the Ocean Park project and what specific technical aspects had to be taken into account?

N. Moser: One unusual feature in terms of ropeway engineering is the fact that the large moving masses of the trainsets have to be accelerated and decelerated on a relatively flat line with a gradient of only 9%. That causes pronounced fluctuations in haul rope tension, which are handled with the help of a hydraulic tensioning system in the lower terminal to produce an adequate level of pre-tension in the counter rope. Apart from that, you have to expect surprises when handling projects on distant shores, and local conditions in Hong Kong (e.g. labor laws) are often subject to specific regulations which Europeans find unusual. But Garaventa/Doppelmayr once again showed that they have the international competence and professionalism to take such obstacles in their stride.

ISR: Thank you for the information.





Photo: Ocean Park

20,000 leagues under the

Upgrade project: underground cable railway to link the two sections of the Ocean Park in Hong Kong. Gangloff Cabins AG is proud once again to be one of the competent partners.

With more than 4 million visitors each year, the Ocean Park in Hong Kong is one of the most popular theme parks in the world. The park covers an area of 870.000 square metres and is built on two sides of a hill. The two halves of the park and their 40 themes are already connected via a continuous ropeway. The upgrade project provides for an additional underground cable railway from Garaventa to link the new attractions, Waterfront and Summit. In accordance with the design of the park, both the interior and the funicular itself will be presented in theme surroundings. The funicular will have space for 400 passengers. Gangloff Cabins AG is proud once again to be one of the competent partners cooperating in the construction of the trains.

Not just amusement

Ocean Park has set itself the objective of bringing visitors closer to nature with its themes. For this reason, the facility does not see itself purely as an amusement park; it also wants to convey meaningful experiences, combined with entertainment and education. This is a prime reason for the park being visited by over 40,000 Hong Kong school students each year. In the year 2000, for example, a research team successfully carried out the artificial insemination of marine mammals for the first time. As a result, two healthy baby dolphins were born in May 2001.

Most modern processing technology

Cars and cabins from Gangloff Cabins AG captivate customers with their modular design and long-term guaranteed spare parts. The frame for Gangloff cars and cabins mainly comprises aluminium profiles developed by the company itself. Special adaptable corner connectors permit the construction of round-off car bodies, which are now a typical feature of today's cable railways. In addition, a steel substructure is used for cable railways, in particular, to transfer the forces to the co-bearing aluminium body. Roofs are presently offered with a choice between glass and sheet metal. Sandwich components are now used for aerial cableways so as to reduce weight. And another important advantage: the riveting method complies with the aircraft industry code.

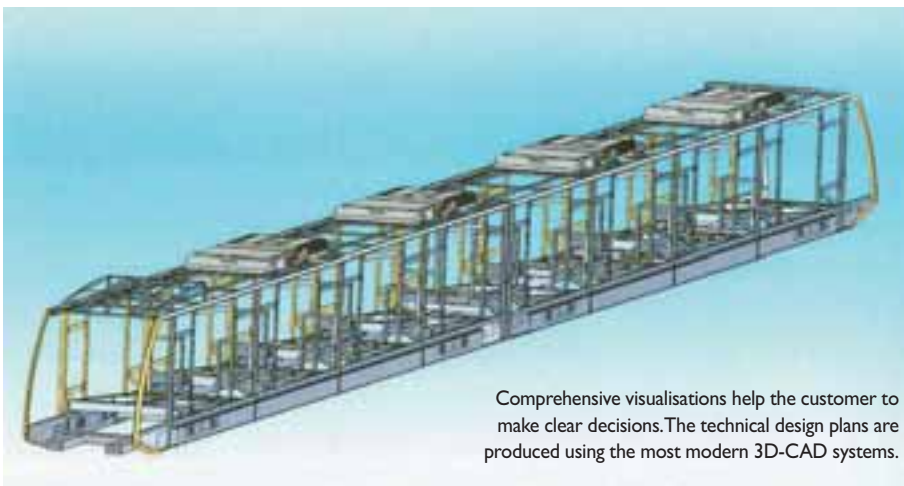


Photo: Gangloff

Comprehensive visualisations help the customer to make clear decisions. The technical design plans are produced using the most modern 3D-CAD systems.



Photo: Gangloff



Photo: Ocean Park



Photo: I Schramm

Gangloff CEO Marc Pfister with the shell of an Ocean Express car

sea in swiss funicular cars

Door operation

Most Gangloff vehicles and cabins use a pneumatic door operation system developed



Photo: Gangloff

by the company itself for single and double-leaf doors. Electric door operation can also be used as an alternative to double-leaf doors. Special aluminium profile systems are available for Gangloff's own door leaves. In principle, however, doors from any well-known manufacturer can also be used.

Fire protection

Sealing electrical systems off from the passenger compartment is part of the primary fire prevention measures in Gangloff railway systems. The underbody is covered with stainless sheet steel in the area of potential fire sources, including the area of the brakes. The careful selection of materials ensures compliance with DIN 5510 as well as other relevant fire protection regulations. A lot is done at the level of fire prevention with the installation of detection and extinguishing systems planned together with specialists in that field. Self-rescue is facilitated through clear interior signs, emergency door release, etc.

Jules Verne's Nautilus

After the vehicles had already been designed as modern-looking cars of the 21st century and the main structures had been built, Ocean Park decided to go for a themed design, looking at Jules Verne's Nautilus adventures. Gangloff designers then started presenting their ideas to the customer in Hong Kong, and after numerous proposals the final fantasy submarine was born.

A lot of craftsmanship was invested to make the cars' exterior and interior look like an old luxury submarine. All the decorations are genuine and not just cheap copies: 20,000 specially manufactured rivets for outside and inside, original copper pipes for the air-conditioning system, oakwood pins on separation walls, and many similar details make the cars look original and at the same time of long-life quality.



Photo: Gangloff



Compacta haul rope on the straight section sheaves

Photos: Fatzer



Rope drum for the counter rope with the rope being drawn in

Photo: J. Nejez

Ropes with strength and endurance

Hong Kong's Ocean Park funicular operates with Compacta haul ropes supplied by Fatzer.



Compacta haul rope supplied by Fatzer

The new funicular has been built to help handle the enormous numbers of visitors to the theme park. The funicular cars, with their unique looks, will be hauled up and down the underground line in complete safety for thousands and thousands of hours at a design capacity of 10,000 persons per hour. That calls for uncompromising standards of reliability; any unplanned stoppages would have unpleasant consequences for the operators and for millions of visitors. So the new funicular was no place for untested products, and there was no scope for experiments with regard to the ropes, either.

Compacta haul ropes

With a track record of decades of safe and successful operation, the Compacta haul rope was the ideal solution to meet the demanding requirements of the ropeway engineering company and the operators in every respect. Like many other funicular railway ropes, the 43 mm haul rope and 26 mm counter rope were produced by Fatzer, the Swiss ropemaking company on Lake Constance. The

strands of a Compacta haul rope are compacted during the stranding process so that the rope stranding is not subsequently disturbed. The increased metal section of the rope resulting from the compacting process permits the same breaking strength to be achieved with more ductile wires of reduced tensile strength for enhanced fatigue strength.

The haul ropes delivered to the Ocean Park funicular on Hong Kong Island do not require any major maintenance work; they can be more or less left to get on with their job. The periodical visual inspections and magnetic induction tests will be the only source of variety in the long service life of the Fatzer ropes!

Fatzer in China

Compacta haul ropes are also taking the pressures of daily operation in their stride in mainland China: in Jiuhua (Anhui), on Emei-shan in Leshan (Sichuan), and on Huang-shan in Hangzhou (Zhejiang). And in Hong Kong itself, 20 km to the west on Lantau Island, 42 mm haul ropes with a total length of 12.5 km are performing reliably on the three stages of the spectacular Ngong Ping 360 bicable gondola that runs from Tung Chung to Airport Island and up to the big Buddha statue at Ngong Ping.

TECHNICAL DATA

THE OCEAN PARK FUNICULAR ROPES

	Haul rope	Counter rope
Diameter	43 mm	26 mm
Length	1440 m	1450 m
Lay	6x25 FW Compacta	6x19 SEALE Compacta
Min. breaking strength	1368 kN	498 kN
Unit weight	7.33 kg/m	2.62 kg/m

Cinema on wheels

The electrical engineering for the Ocean Park funicular was supplied by Frey AG of Stans. The on-board systems for the cars far outstrip anything seen before.

What is probably least striking about a ropeway is the electrical engineering. And yet it is of decisive importance for safe and reliable operation. In the case of the Ocean Park funicular, all the electrical systems have been supplied by Frey AG of Stans. Professor Josef Nejez, ISR's technical editor, interviewed Hans Schneider, Sales and Marketing Manager at Frey AG, on the subject of this unusual funicular with its various unique features.

J. Nejez: How much of the electrical engineering for the Ocean Park funicular was supplied by Frey AG?

H. Schneider: The question is easy to answer: all of it, i.e. the control system, the double drive with frequency converters, the inductive and capacitive remote monitoring system – meaning the link between the lower and upper stations and between the stations and the cars – and all the other communications and visualization systems.

J. Nejez: Did the cars have any special features that your company had to provide for?

H. Schneider: You can say that again! The various extras ordered by the operating company were a real challenge for us and for Gangloff. For example, passengers will be treated to a video show complete with sound effects with the help of big screens on the car ceilings. That was not exactly a standard job for us.

J. Nejez: So the cars are like little cinemas on wheels.

H. Schneider: Yes, you might put it like that. At all events, with features like that plus a big air-conditioning system, power consumption in the cars is much higher than on conventional funiculars. The latter can be equipped with floating batteries to keep their electrical systems supplied on the line, but that would



Professor Nejez spoke to Hans Schneider (right), Sales and Marketing Manager at Frey AG, at Swiss Alpina, with Frey's Product Manager Tabord Albert (left) also present.

not be sufficient for the Ocean Park funicular. So we had to provide conductor rails along the full length of the track. And the whole system, including the power supply to the conductor rails and the power take-off on the cars, was part of our contract.

J. Nejez: What did the schedule look like for all this work?

H. Schneider: Well, I don't remember the exact dates, but the control system with the switch cabinets was delivered in autumn 2008. Gangloff finished the cars around the turn of the year, and installation of the electrics started in January and was completed in February. Then the cars were shipped to Hong Kong.

J. Nejez: I happened to be in Hong Kong at the time and was able to observe the maiden journey of the car and installation of the counter rope, as described in my article in ISR 2/2009.

H. Schneider: Yes, that was a real coincidence. Erwin Amstad, our commissioning expert, told us about it. Your visit to Hong Kong coincided with the first phase of commissioning. It was all very complicated, especially coordinating the various activities with the work still going on in and on the terminals.

J. Nejez: I can believe it. The language difficulties and the differences in mentality obviously make it harder for everyone to pull together.

H. Schneider: And between now and the official opening, we naturally have someone out there to see to the finishing touches and be available to fix any problems that might arise.

J. Nejez: Thank you for your time.

TÜV SÜD certificate for Hong Kong

The Ocean Park management place their trust in the inspection and testing services provided by TÜV SÜD. In the following interview, ISR discovers why.



Photo: TÜV SÜD

From left to right: Gary Wong, EMSD (licensing authority in Hong Kong); Nefield Kiang, Ocean Park; Frank Seyfried, TÜV SÜD; Uli Zbil, TÜV SÜD; Erwin Amstad, Frey AG (control system supplier); CW Chan, Ocean Park.

ISR: How did cooperation between Ocean Park and TÜV SÜD come about?

U. Zbil: Cooperation between Ocean Park and TÜV SÜD actually dates back about thirty years, when Ocean Park acquired some amusement rides from Germany. The German manufacturers went to the experts at TÜV SÜD in Munich as usual and had them check the technical documents and also perform the on-site acceptance tests. Although that was not a legal requirement, the manufacturers wanted to have the audits handled by an organization that was noted for its high standards so as to minimize the risks and their liability as far as possible. After that the Ocean Park managers themselves hired the services of TÜV SÜD for the regular inspections, which were extended to the two aerial cable cars in the theme park. Since then, TÜV SÜD has carried out many acceptance tests for amusement rides and annual surveys for the Ocean Park Cable Cars. The Ocean Park management and the Hong Kong authorities EMSD (Electrical and Mechanical Services Department)

have always appreciated our high level of routine with safety audits and our expertise in the various disciplines, namely control engineering, steel and mechanical engineering, construction engineering and fire safety. One-stop shopping for full inspection and testing services in all these fields is one of the strengths of our organization.

A number of years ago, TÜV SÜD opened an office in Hong Kong, and clients like Ocean Park now have the cost-effective option of contacting us locally without any restrictions on the technical services available. Ocean Park's positive experience of working with TÜV SÜD Hong Kong office was naturally decisive for Ocean Park's decision to place the relevant contracts with us for their redevelopment project.

Eight other amusement rides are currently on TÜV SÜD's order books for a safety audit and they will be subjected to design review and form 3 approval.

ISR: What were TÜV SÜD's duties in the context of the application for a permit to use for the Ocean Park funicular?

U. Zbil: In formal terms, the tasks assigned to an inspection body in Hong Kong are similar to those in Europe. To obtain the permit to use, the company must appoint an independent surveyor with official accreditation in Hong Kong, who performs an acceptance inspection, and the inspection report must accompany the application for an operating license.

Strong emphasis is placed on a full inspection by experts in line with the four eyes principle. After all, complex systems have a large number of interfaces between the various sub-systems. The demands imposed by the mechanical assemblies on the electronic control and monitoring systems, for example, necessitated painstaking testing by our inspectors for correct functioning. In the course of the final acceptance tests we attach great importance to interaction between the various systems and functions and also examine the interfaces to the operation. Here it is of importance to us that from a technical safety perspective, passengers or operating personnel are in no danger, also in the case of a system interruption or failure, and that the operator can apply a high level of system understanding during the operation of the equipment.

In five days in May 2009, TÜV SÜD handled the main body of the work for the acceptance tests for the Ocean Park Express funicular with the help of an electrical engineer and a ropeway engineering expert: Frank Seyfried, an experienced control engineering specialist who has been working for TÜV SÜD from Shanghai for the last four years, and Uli Zbil, head of the department for ropeways in Munich. The second and final inspection relating to the ropeway and electrical engineering as well as such features as passenger flows in the stations, including guidage systems and automatic doors, were performed in June 2009 with positive results.

ISR: Does TÜV SÜD have special experience of the situation in Asia, and were there any differences compared with the procedures for final approvals in Europe?

U. Zbil: As already mentioned, TÜV SÜD has been handling contracts in Asia for many years now, and we are familiar with the mentality of the people we work with in the course of our inspections. Obviously it is a big advantage in terms of time requirements if – as in the case of the Ocean Park funicular – the representatives of the manufacturers and the testing body can discuss the various points in their mother tongue. In the case of other ropeway installations that TÜV SÜD has inspected in Macau, mainland China and Singapore, it is often more difficult and takes longer to communicate the specific technical details.

Andreas Kraushaar, project manager for Doppelmayr-Garaventa, gave a convincing demonstration of his long years of experience during the commissioning of the Ocean Express. Thanks to the excellent job he did in preparing the technical documents, the serious work for the acceptance test procedures could begin very quickly and was completed expeditiously. The same goes for Erwin Amstad of Frey AG, who handled the electrical engineering, the control and monitoring systems, and the drive and visualization, and commissioned the installation with his usual calm routine and had no difficulty in responding to the inspectors' critical comments and questions.

We are proud of the trust that Ocean Park has placed in us and grateful for the frank and committed spirit of cooperation shown by the manufacturers and the technical management at Ocean Park. We would like to take this opportunity to wish the Ocean Express a successful opening and long years of accident-free operation.



Photo: Ocean Park

AMUSEMENT RIDES AND LEISURE PARKS

AS AN EXPERIENCED, IMPARTIAL EXPERT ORGANISATION, TÜV SÜD BOASTS OVER 70 YEARS OF INTERNATIONAL EXPERIENCE IN THE TESTING AND APPROVAL OF AMUSEMENT PARKS, RIDES AND STRUCTURES. TÜV SÜD GROUP IS YOUR EXPERT PARTNER IN ALL ISSUES CONCERNING THE PLANNING, CONSTRUCTION OR SAFE AND COST-EFFECTIVE OPERATION OF YOUR FACILITY. WORLDWIDE.





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