BIRKET ENGINEERING NEWS

Electrical & Software Control Systems for Safe Rides & Shows Since 1984

Fall 2003

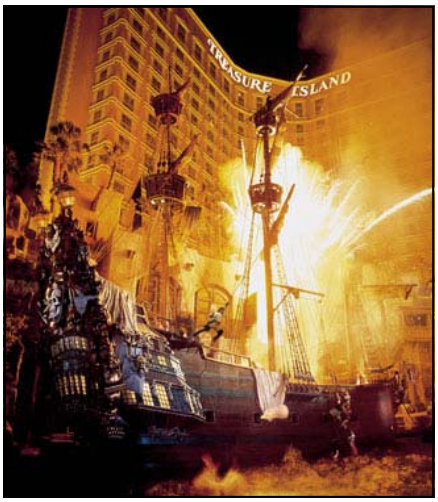
ATTRACTION SAFETY

New 'Sirens of TI' at Treasure Island in Las Vegas

Press Release information courtesy Treasure Island at the Mirage©

The countdown has begun to the maiden voyage of TI's new pirate battle production. The new show features the Sirens of TI, sexy females who battle it out with a band of renegade male pirates in a modern interpretation of the Battle of Buccaneer Bay. The production is the centerpiece of TI's evolution and debuts October 26 in celebration of the resort's 10th anniversary.

In 1992 Birket Engineering created and commissioned the special-effects controls for the original Buccaneer Bay show, an industrial PLC-based subsystem which is still running today. For its 10-year anniversary, Treasure Island selected Birket Engineering to remove its aging PC-based master control system and replace it with another industrial-quality control system. The DOS-PC equipment was no longer supported or available after a few years, while the industrial-grade equipment was still in-stock and compatible.



The new master control system marries an Allen-Bradley "safety controller" with an Anitech Systems "show controller" into a synergistic system that seamlessly handles both safety-intensive control and conventional theatrical control.

The new combined master controller interfaces with the updated Birket special-effects subsystem controller to cue flames and pyrotechnics, with the updated hydraulic controller to cue ship motions, and to the updated audio and lighting subsystems.

The original button and light studded control console was replaced with a simplified "TD" console featuring a touch-screen terminal with collected status from all the subsystems and effects. The critical cue-control, effect-enable, and emergency-stop buttons have been relocated to a mini-console under the Technical Director's fingertips as he directs the show from above the lagoon.

See www.treasureislandlasvegas.com for more information.

Building 'Boring' Rides and Shows

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Theme park engineering can be viewed from many perspectives. Ask a friend about their favorite theme-park ride and you'll likely hear an animated recollection of how high, how fast, and how scared they were – and how many times they rode it again. Read a theme park's brochure and you'll see adjectives like "exciting", "thrilling", and even "death defying". Ask a high school physics student to name the branch of engineering he would like to work in and you'll often hear "designing roller-coasters". However, if you ask an entertainment industry engineer about his work, you'll learn that their real goal is to design attractions that look exciting, but are actually boring.

This kind of "boring" is good because it is safe, reliable, and profitable. Years of operation without an injury are boring for the paramedic staff. Weeks on end without a challenging equipment breakdown are boring for the maintenance staff. And while the endless flow of smiling, paying guests day after day may be boring for the operations staff, it's a successful attraction when the only people who get excited are the guests and the stockholders.

The reality behind the eye-catching façades is that the people designing, maintaining, and operating theme-park attractions are very conservative. They're cautious because these attractions attract a lot more than smiling guests. A theme park is a lightning rod for a wide variety of unwanted attention ranging from disappointed guests demanding a rain check, to lawyers fishing for a lucrative out-of-court settlement, to media and politicians hoping for publicity. Knowing that on a slow news day a stranded roller coaster will soon have helicopters buzzing overhead has made the entire industry, in the words of one park executive, "risk adverse."

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This Issue

This newsletter is provided by Birket Engineering, Inc. as a communications device to current and future customers and friends.

Every control system must be evaluated and designed with consider-ation for the details of the specific application.

Information in this newsletter is not meant to be an engineering or professional opinion.

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CONTROL SYSTEM DESIGN

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This industry-wide defensive posture governs the creation of a new ride or show. While artists still give their imaginations nearly free rein with an attraction's appearance, engineers and managers focus on eliminating threats to safety, reliability, and efficiency. Designs tend to be limited to proven technologies, trusted equipment, and timeworn techniques. While the design requirements are frequently bizarre and problems may be unusual compared to other industries, the engineering applications that satisfy the designs are as simple and mundane as possible.

An example of simple solutions to strange requirements is at a popular stunt show in a major Japanese theme park. The show features a battle on, under, and around an artificial lagoon in the center of the stage. At one point the script calls for a stricken, smoking seaplane to crash through a wall of the set, splash down into the stage's lagoon, explode in flames and shower the audience with water – in complete safety – eight shows a day, for ten years – without costing a lot.

No problem.

The team of engineers assembled to bring this artistic vision to life started with a significant advantage: they had literally done it all before. Not only was the show the second of its name (the first one having opened years earlier in Southern California), but many of the vendors and engineers who created the original award winning attraction were back for an encore. The project planners knew that hindsight of what worked and what didn't would be a powerful tool to mitigate risk.

Among the design tenets of safety, reliability, and efficiency, safety is supreme in this environment by a wide margin. For this stunt, safety includes not dropping the free-falling seaplane onto a stuntman, crashing it into the set, or throwing it into the audience. The safety solutions employed are simple, and typical of the entertainment industry. An engineer working in another industry might think they are unusually cautious until he considered the entertainment environment. In some industries, safety focuses on stopping the machine when someone gets too close; but in the entertainment industry (among others), the machines must be safe while people are in them or interacting closely with them.

Safety is ultimately the responsibility of people, not machines, and the architecture of an attraction's safety system embraces that premise. Experienced crewmembers vigilantly watch the set from multiple vantage points to ensure that cast, crew, and audience are all well clear of each stunt's hazards. Surveillance cameras reveal any hidden areas and the vantage points shift as the action moves around the set. The set design provides open sight lines to critical areas. Not only does the audience have a clear view of the action, but also the spotting crew has a clear view of the entire audience.

Do you have a controls question on a specific ride or show application? Birket Engineering, Inc. invites inquiries. We are fortunate to have a wealth of experience and talent from which to draw to address your need.

As you would expect, every vantage point and every control panel is equipped with an Emergency-Stop pushbutton. What isn't obvious is that they all do exactly the same thing. The backstage area of a stunt-show with a hundred effects managed by two-dozen control subsystems is a maze of electrical conduits, hydraulic and pneumatic lines, and control boxes. To eliminate the problem of finding the "right" E-Stop button in an emergency, every sub-system in the venue is required to participate in an attraction-wide E-Stop architecture. An entertainment industry interface specification detailing the interconnection of E-Stop buttons in cabinets from different vendors and a fail-safe hierarchical E-Stop power bus structure ensures that when a crewmember hits the closest big red button, everything will stop, regardless of who built it.

Each spotter location also has one or more "effect-enable buttons" that must be held down continuously to allow effects to begin or continue. Additional buttons, photo-eyes or other sensors protect stuntmen involved in apparent narrow escapes. Anyone releasing a button or missing a sensor will cancel an effect before it begins or stop the action already in progress. If an actor fails to reach the safety of his "mark" within the scripted time, the seaplane won't fly, the explosions will abruptly stop and the gas-fed flames will snuff out. Like the Emergency-Stop system, the independent effect-enable matrix system operates in parallel with the attraction's control computers. The control system continually supervises the enable matrix and E-Stop logic in detail. A failure will cause the controller to shutdown the affected area or the entire attraction as dictated by the safety analysis.

Behind the set, the seaplane's launcher is surrounded by a high fence and monitored by security sensors integral to the show's safety control system. After the stage crew reloads the launcher with its seaplane between shows, the stage manager checks the enclosure for stragglers, closes and locks the gate, and arms the security system. Any attempt to reenter the area, even for maintenance, will trip the alarm and abort a launch. The control system helps to enforce that maintenance and operation remain safely separate activities.

The fake seaplane was designed to be aerodynamically inert so that it follows its programmed trajectory reliably and exactly. Despite its appearance, this "seaplane" has more in common with a falling rock than a real aircraft. To prevent a sudden gust of wind from disturbing its "flight", five strategically located anemometers continually monitor wind strength and direction. Too strong or too erratic a wind will veto a launch. The same wind sensor system disables aerial pyrotechnics and snuffs flames, each according to their own safety parameters. The wind history along with a technical

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BRIAN KUHAR

Delta loves Brian Kuhar. Orlando to Madrid. Orlando to Kansas City. Orlando to Osaka. Orlando to Germany. Orlando to Lake Buena Vista. Okay, so the airlines don't make any money on his trips to the latter site. Still, see Brian's laptop for the stickers certifying his frequent globe-hopper status. Since beginning with Birket Engineering in 2000, Brian has played key roles in the design and installation of multiple world-class attractions.

Brian spent May this year in Germany engineering the from-scratch conversion of an existing action-stunt show. Warner Brothers Movie World Germany re-christened their 'Police Academy Stunt Show' as 'The Real Hollywood Stunt Show'. As a result, the project required the ground-up design and programming of the effect and life-safety systems hardware and software. The transformation was completed by Brian in an amazing 22 days!

This past December Brian successfully demonstrated the STROBE-BRIK system to representatives from Gallegos Lighting Design and the Argosy Casino in Kansas City, MO. The new 840-strobe system opens at the casino on December 7 this year.

Brian on a typically beautiful day in Orlando

Currently Brian works as Birket project engineer for an upgrade to a local attraction. As you might expect, when not designing and installing the next attraction control system, self-confessed theme park fanatic Brian and his family maintain annual passes to Orlando-area parks.

See brian.kuhar@birket.com.

Work-in-progress with Brian

The Stats on Brian

System Engineer, Birket Engineering, 2000-present
Show and Ride System Integration
Work-in-Progress, Orlando-area attractions
The Real Hollywood Stunt Show, Warner Brothers Movie World Germany™
Lethal Weapon Stunt Show, Warner Brothers Movie World Madrid™
Animal Actors Stage®, Universal Studios Japan™
WaterWorld™, Universal Studios Japan™
Snoopy's Sound Stage Adventure®, Universal Studios Japan™
Hollywood Magic™, Universal Studios Japan™
Universal Monsters Live Rock and Roll Show, Universal Studios Japan™
Wild Wild Wild West Stunt Show℠, Universal Studios Japan™

Bachelor of Science in Electrical Engineering, 2000
The Pennsylvania State University
Honors Student

Engineering Intern, Walt Disney Imagineering, 1998-1999
Provided engineering installation support for EPCOT's Illuminations 2000, developed company-wide post-turnover support program (WDI-WDW Warranty Program).

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show log and detailed diagnostics are continuously recorded in a permanent log.

Long before the first launch of the seaplane on set in Japan, the launcher system underwent months of testing on San Francisco Bay to prove its safety and demonstrate its reliability over hundreds of launch cycles. Every component's failure-modes and diagnostic messages were provoked and demonstrated to be fail-safe before the first show to an audience. During most of these exercises, the launcher was loaded with an ungainly and decidedly un-aerodynamic construction of I-beams and concrete-filled 55-gallon drums christened the "Flying Pig".

As in any safety critical design, a failure analysis determines to what extent we can rely on any component of the system. In this case, the design does not rely on the computer to control the launcher during the critical moments of launch. To ensure that the seaplane is neither thrown too long nor too short (where it might fail to clear the wall), the launcher design resembles a large spring-powered crossbow. Once triggered, it is sure to complete a full-speed launch with a pre-measured supply of energy.

A fixed-capacity hydraulic accumulator stores exactly the energy needed to accelerate the fixed-weight vehicle along its calculated trajectory. Because the launch is powered by the carefully controlled potential energy of a compressed nitrogen tank, a power failure or computer glitch in mid-launch can't cause a short launch. The control system monitors the process for any of several hundred anticipated and instrumented failures and then – providing everything is in the green – simply triggers the redundant launch valves to release the hydraulic

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MGM MIRAGE, headquartered in Las Vegas, NV, owns and operates 14 casino resorts: Bellagio, MGM Grand Las Vegas, The Mirage, Treasure Island, New York - New York, Boardwalk Hotel and Casino, Whiskey Pete's, Buffalo Bill's, Primm Valley Resort, Beau Rivage, MGM Grand Detroit Casino, Golden Nugget Las Vegas, Golden Nugget Laughlin and MGM Grand Australia.

Source: www.mirageresorts.com.

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"spring". As with the wind data, the launch control system writes detailed graphs of important process parameters and extensive diagnostic messages to a remote computer.

The launcher's framework is another proven technology in an unusual application. The launch carriage resembles the base of a roller-coaster car and rides on an aborted segment of steel-tube roller-coaster track. A hydraulic piston and pulley system like those used on some modern roller-coaster launch systems accelerates the carriage up its short track. The deceleration of the carriage at the top disengages the vehicle, which continues through the breakaway wall. The seaplane never actually hits the breakaway wall, despite its appearance of crashing through and leaving burning rubble in its wake. A pair of large air-cannons actually knocks the painted foam wall down a few hundred milliseconds before the seaplane passes through the opening. A combination of pyrotechnics and a gas burner flame-effect system provides the scripted conflagration. The safety control system enforces that all the necessary elements play out as scripted or not at all. For example, a launch failure will prevent the flame system from toasting the still-intact flame-resistant foam wall.

The seaplane arcs though the air, trailing smoke from one damaged propeller. The other propeller is "still" spinning, actually driven simply by airflow. Showers of sparks erupt from the fuselage as it impacts the water. Its momentum carries the burning hulk downstage to its submerged landing platform close to the audience – where it unexpectedly produces a final, loud, and very wet explosion.

The smoke, sparks, and flames are all generated by pyrotechnic charges snapped into permanent holders on the fuselage sides and wing tops. The holders are shaped to direct their explosions in a safe direction. An onboard pyrotechnic system enabled by the attraction's safety control system via a wireless link triggers the charges. Any interruption of the link back to the spotter's enable-buttons will disable the onboard pyro system. The final wet explosion is produced by both onboard and shore-mounted pyrotechnics together with two shore-mounted air-powered water cannons. The "lagoon water" allowed to reach the audience is actually filtered drinking water.

All of these safety systems: distributed E-Stop interface, effect-enable matrix, wind monitoring, extensive fault detection, system self-checks, and more are all biased to disable the effects if anything unusual happens. It is not enough that the system not notice anything wrong – it must confirm that everything is right before it will enable the effects. As difficult as it can be to meet all the strict safety requirements, the cast and crew consider it a victory when a show works perfectly. But the occasional missed effect also assures them that the safety features work. They know that they can blow up and burn down their workplace eight times a day and remain safe at their "boring" attraction.

The complete article with additional text and images may be seen in the December 2003 IEEE Instrumentation & Measurement Magazine.

Birket Exhibits at LDI 2003 in Orlando, Booth #1846

The Entertainment Technology Show-LDI 2003 will be held November 21-23 at the Orlando Convention Center. The Birket booth, #1846, will showcase the company's engineering services and themed entertainment specialty products. New for 2003 is the **STROBE-BRIK EZ™**, a streamlined version of the popular **STROBE-BRIK™** multi-strobe controller. The EZ system provides daisy-chainable strobe controllers with resident lighting sequences and does not require DMX programming. Also debuting is a threaded-base strobe, allowing strobes to be changed like a light bulb.

This year's show overlaps the IAAPA convention's dates of November 19-22, also at the Orlando Convention Center. Birket is attending, not exhibiting, at IAAPA. Badged IAAPA guests may attend the LDI show without charge. LDI VIP passes may be obtained by contacting Steve Birket at (407) 290-2000 x126.

See www.birket.com/strobes/default.htm for more information on the **STROBE-BRIK™** *system.*

BIRKET ENGINEERING, INC. WORK IN PROGRESS

Current Projects

- The new show control system for Treasure Island's 'Sirens of TI' is commissioned.
- A new US linear induction motor-launched roller coaster control system is installed.
- A filter control system for US Filter is in fabrication.
- Assembly and installation of operator consoles continues for an Orlando-area thrill ride.

STROBE-BRIK™ Systems

- An 840-strobe system opens December 7 at the Argosy Casino in Kansas City.
- A 24-strobe system ships to the Gran Chapur in Mexico.
- A 128-strobe system lights up the Shoreline Drive Pedestrian Bridge at the Long Beach Pike in CA.
- A 250-strobe system ships to a new Hong Kong park.
- A 300-strobe system is assembled for a Japanese theme park.

Upcoming

- The conveyor controls design begins for an Orlando-area water ride.
- Enhancements to the *PYRO CONDUCTOR™* system are planned.
- The **STROBE-BRIK EZ™** will debut at the LDI New Technology Breakfast in November.
- Various projects are pending for a new park in China.

See www.birket.com for more information.