Case Study: New Bedford Panoramex Corporation

SNAP PAC Controllers and I/O Systems Are Key Components in Company's Aviation Lighting Systems

Introduction

On any given day, there are more than 25,000 commercial flights in the U.S. What all of these flights have in common is that they all begin and end at an airport. As part of their critical infrastructures, all airports require an arrangement of approach, runway, taxi, and other lighting systems to guide and assist pilots as they take off and land their planes.

New Bedford Panoramex Corporation (NBP), based in Claremont, California, develops and manufactures essential navigation and landing aids, and lighting and control systems for the aviation industry. The company has completed product installs at all of the nation's largest, most heavily trafficked airports, including John F. Kennedy in New York City, O'Hare and Midway in Chicago, and Dulles in Washington D.C.

"Over the past 26 years, we've developed, programmed, and implemented a large selection of equipment with both wired and wireless interfaces used to control critical lighting systems at airports," explains Dean Munson, Senior Hardware Engineer at NBP. "Even though many of these systems are unobtrusive and are tucked away in control towers or way out on the end of runways, the fact is without them, commercial aircraft all over the country simply would not be able to land safely."

An examination of some of NBP's most widely deployed lighting control systems finds that their key components are programmable automation controllers and intelligent I/O systems from Opto 22. Among other things, the hardware provides the interface and intelligence used to sequence lights and adjust their intensity. NBP Program Manager Larry Davis says that for some of these systems, an Opto 22 SNAP PAC programmable automation controller replaces an embedded single-board controller that took five times as long to program (using "C" code) than the flowchart-based programming used for the SNAP PAC.

NBP aviation systems include ALSFs, RRCSs, PAPIs, and ICMSs.

Approach Lighting System with Flashers (ALSFs)

ALSFs provide aircraft a way to transition from instrument flight to visual flight for landing. They are installed on the approach end of larger airports all over the country, and consist of a series of flashing lights that extend the center line of the runway outward. ALSF lights operate at five different levels of intensity and a typical configuration consists of a combination of steady burning lights along with sequencing strobe lights. NBP's ALSF control systems are installed in full 3,000-foot lighting patterns, or in shorter 2,400-foot patterns, and can be controlled locally or remotely from the air traffic control tower. To accomplish this, the towers are equipped with a remote control system that was programmed by NBP to monitor and control the lights.

In some airport approaches where air space is partially restricted, additional light segments are employed as a Lead-In light approach. These Lead-In approach light segments are often deployed across nearby terrain (and sometimes on the tops of building) in the approach path of the airport runway. In some cases where there are parallel runway approaches, runway

Lead-In light segments may be shared by planes approaching the two runways.

NBP has designed, programmed, and deployed Opto 22-based systems to manage both ALSFs and Lead-In lights for airports all across the country. These systems include analog input modules that monitor power supply voltage input status, digital input modules to track system on/off status and detect operational faults, and digital output modules that enable remote on/off switching.

Remote Radio Control System (RRCS)

An exclusive system developed by NBP, the RRCS interfaces to and provides remote control of numerous visual aids and airport equipment. The RRCS is used by air traffic control towers to access and control this remote field equipment, switch these visual aids on and off, choose lighting intensity levels, and generally monitor these systems' status.

Significantly, the RRCS offers both wired and wireless connectivity. Wireless communication takes place over specific FAA-assigned radio frequencies. The RRCS also handles status and control of wired equipment utilizing frequency-shift keying (FSK)[1] over serial connections.

"The wired interface used for the RRCS, and most of our systems, is a combination of serial and FSK," says Davis. "Serial, as the physical medium, gives us a good choice for maintaining a strong signal over the very long distance runs from the towers to the field equipment. And FSK over serial's twisted pair [wiring] gives us a simple, virtually noise-immune communications protocol that transmits at an acceptable speed."

Precision Approach Path Indicators (PAPIs)

PAPIs consist of an arrangement of four horizontal lights positioned on either side of the runway. PAPIs are designed to provide a pilot with a visual indication of whether or not his plane is on the proper glide path for the runway approach. The perceived color of the individual PAPI lights changes depending on the glide path of the approaching

The RRCS, which comes with both wired and wireless connectivity and a touchscreen interface, is a new system that will be initiated at the Vero Beach Municipal Airport next year, followed by additional deployments at many other airports.

aircraft. For example, when the pilot is on the correct approach angle, the two right lights on the NBP PAPIs appear red, and the two left lights appear white. Three white lights and one red light indicate slightly high; four white, significantly high; three red, one white indicate slightly low; and four red is significantly low.

An embedded SNAP PAC controller provides the intelligence the RRCS needs to generate control signals that turn the PAPI on or off. The PAC also monitors the PAPI's operational status, including "Tilt Condition" and "Lights Out" warnings.

"Also, it's important to understand that there are numerous manufacturers of PAPI systems," explains Davis. "Many of these systems are switched using either 5 or 15 volt logic. In order to serve a greater share of airports all over the country, it's very important for us to have the versatile Opto 22 I/O that can switch relays with these varied voltages."

Additionally, tremors or other earth disturbances can sometimes affect the PAPI's alignment. This could potentially alter the visually projected glide path indication that incoming pilots might be seeing, and cause them to misjudge whether or not their landing approach is correct. To safeguard against this, NBP's RRCS system monitors the PAPI status for a number of variables, including its geographical position alignment. If the PAPI's alignment is disturbed, the local I/O sends an alert back to the control tower.

1. With FSK, data is converted into a binary form in which a "1" is represented by an analog waveform at a specific frequency, and a "0" is represented by a wave at a different specific frequency. The digital information is then transmitted through discrete frequency changes in the carrier wave.

PAPI systems have an effective visual range of at least 3 miles during the day and up to 20 miles at night. Light combinations indicate when slightly high (3 white), significantly high (4 white), slightly low (3 red) and significantly low (4 red).
Source: www.FFA.gov

NBP has also developed a next-generation PAPI that utilizes LED lights in place of conventional bulbs. With white LEDs on the bottom and red on the top, light is projected onto a mirror, and then intensified and reflected by the PAPI's lenses and spreaders to create the arrangement of lights the pilot sees.

"Thus far, our LED-based system has proved far superior to halogen or incandescent lights," says Munson. "They operate effectively in both day and night mode; the LEDs' power consumption is far less (800 watts compared to 2400 watts) and their lifespan is 25 times longer. This means they only need to be replaced every five and a half years compared to every three months for standard bulbs. We've done extensive testing of the system with FAA at the William J. Hughes Technical Center in Atlantic City, NJ and have refined the system for rollout in 2012."

Integrated Control and Monitoring System (ICMS)

The ICMS is a hard-wired system deployed at larger airports (including Chicago's O'Hare and New York's John F. Kennedy.) The ICMS is very similar to the RRCS, but has more comprehensive monitoring and control capabilities. In addition to visual aids like PAPIs and ALSFs, the ICMS also monitors the more critical navigational aids, such as distance measurement equipment[1] and instrument landing systems (ILS). The ICMS plays a vital role by monitoring airports' "interlock systems", ensuring that instrument landing systems sharing a common frequency or facing each other on a common runway are not operating at the same time, and are not experiencing cross modulation or other interference that could cause landing problems.[2]

"We always look to embed the highest performing and most reliable components in our aviation lighting control systems," says Davis. "We're able to provide solutions appropriate for the nation's largest airports, down to small landing strips, and over the years, successive generations of Opto 22 hardware have proven powerful, cost-effective, easy to implement, and extremely durable."

1. Distance measuring equipment (DME) is transponder-based technology used to calculate distance by sending, receiving, and timing radio signals.
2. Some large airports have multiple runways. (O'Hare, for example, has eight runways and each has two approaches.) With planes able to land at either end of the runway, the correct instrument landing system needs to be activated. The FAA therefore mandates implementation of an interlock system to toggle multiple instrument landing systems employed at a single airport.

About New Bedford Panoramex Corporation

Since 1966, NBP has established an undisputed reputation for innovation, quality, performance and integrity in the engineering, design and manufacturing of Landing Visual Aids including Approach Lighting Systems and Monitoring and Control Systems for the aviation, utility and defense industries. NBP also offers training and field support services.

NBP's business philosophy, conceived and built upon a continuing dedication to integrity, quality and performance, has been, and remains, the catalyst around which the company has been able to achieve its goals. NBP's ongoing commitment to planned growth while remaining competitive has firmly established the company as a leading, diversified, advanced technology company throughout the world.

About Opto 22

Opto 22 develops and manufactures hardware and software for applications involving industrial automation and control, energy management, remote monitoring, and data acquisition. Opto 22 products use standard, commercially available networking and computer technologies and have an established reputation worldwide for ease-of-use, innovation, quality, and reliability. Opto 22 products are used by automation end-users, OEMs, and information technology and operations personnel in over 10,000 installations worldwide. The company was founded in 1974 and is privately held in Temecula, California, USA. Opto 22 products are available through a global network of distributors and system integrators. For more information, contact Opto 22 headquarters at +1-951-695-3000 or visit www.opto22.com.

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