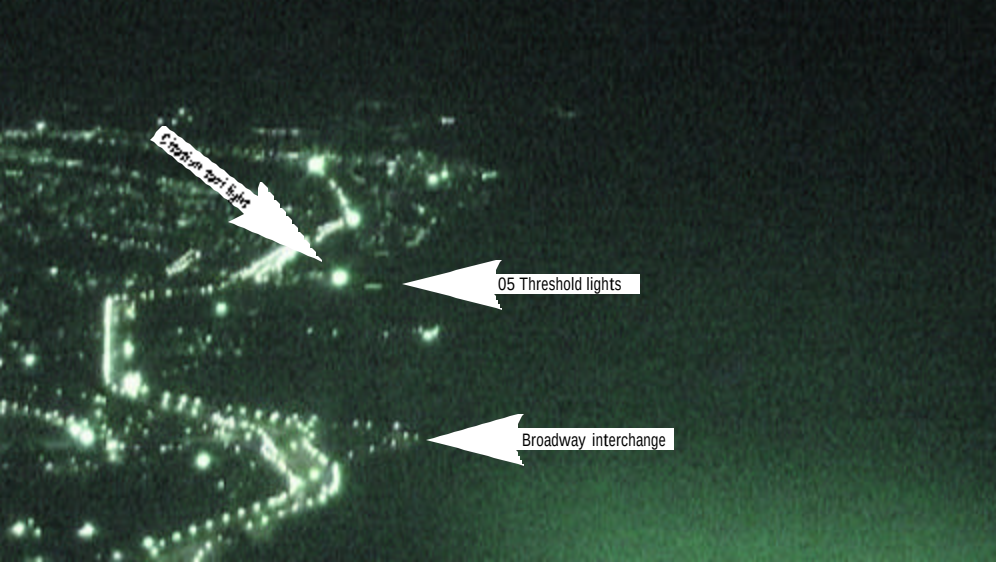

DURBAN ENGINEER DEVELOPS UNIQUE EMERGENCY RUNWAY LIGHTING SYSTEM

Designed for emergency use in rural areas, the system can also be employed as a back-up for existing electrical flarepaths

SEVERAL NEAR-fatal accidents at night, some brilliant intuition, coupled with lots of frustration, experimentation, co-operation with pilots and the authorities alike, plus some downright hard work has led to the development of an unique emergency runway lighting system being introduced by a Durban civil engineer.

News of the emergency system comes hard on the heels of that of another runway solar-powered lighting facility *(see World Airnews, April 2004)*, both of which are currently being studied by the South African Civil Aviation Authority (CAA) prior to certification. The solar-powered SunSolutions system is designed for upgrading commercial, private and general aviation airports and airfields.

The other new system, however, is initially being targeted for emergency use, such as ambulance aircraft operating into ill-equipped airfields at night, but which could also be used on private airfields or as emergency back-up to existing lighting systems should they fail for any reason, such as lightning strikes.

Brainchild of Durban engineer Gavin Brown, the emergency system consists basically of two rows of reflectors which line the runway edges, and car battery-powered threshold and runway end lights. Brown, a commercial and glider pilot had been worried for some time about the hazards facing the Red Cross Air Ambulance Service when its aircraft have to operate into and out of unlit runways in all weather.

He recalls a time when he was on board a Red Cross Pilatus PC-12 waiting to airlift a patient from Nongoma to Durban at night. The aircraft had earlier being lined up on the runway at sunset but it was dark by the time the patient was loaded aboard. The pilot requested the ambulance driver to illuminate the runway end with his vehicle's lights. Instead, the ambulance drove off, leaving the Red Cross crew with a problem.

These digital images (enlarged slightly to improve clarity for printing) were taken from a video tape used in a camera mounted in a Red Cross PC-XII during tests conducted at Virginia Airport, Durban, earlier this year. The approach is towards Runway 05. The top one shows the runway end lights clearly visible at a distance of over four kilometres on a fairly high approach. The photograph above was taken at a distance of about two kilometres with the runway edge reflectors now clearly visible. The images on the opposite page were taken on short finals (upper) and on flareout with the lighting as good as, if not better than, any standard electric flarepath.

Suddenly they saw a fire in the distance virtually positioned on the extended centreline of the runway. The fire was in a kraal and was seen through the open door of the building. Wasting no time, the aircraft began its takeoff run towards the fire, but halfway down the runway, someone closed the door of the kraal leaving the aircraft to take off blind.

"It was a hairy experience," recalled Brown, "and there and then I decided to try and find a way to provide some form of relatively cheap and effective runway lighting. I realised that this incident was one of only many incidents that occur on a regular basis throughout the country, not only for aircraft on mercy flights, but also involving aircraft finding themselves in an emergency situation.

"For example, a light aircraft took from Wonderboom Airport, Pretoria, recently on a night flight. The pilot found the weather was deteriorating ahead of him and elected to return to Wonderboom only to discover that the lights had failed due to a lightning strike. He had to land in the dark damaging his aircraft but without injury to himself or his passengers."

Brown wasted no time in launching his project. Then began the frustration.

He at first experimented with bicycle and car reflectors setting them up at various angles at first on the main fairway at Beachwood Golf Club, Durban North, and then later at Virginia Airport. Aircraft were flown on "dummy" approaches to test whether their landing lights would pick up the reflectors.

"The best result we could get from

banks of these reflectors was a visual range of a couple of hundred metres, totally unacceptable for safe flying. We tried all angles and all manner of reflectors without success.

"Then, one day I was at a friend's house at Pilgrim's Rest, in Mpumalanga," Brown continued, "and we were sitting outside one evening. Now and again I would see a flash coming from a road some distance away. Then it struck me – .the flashes were car lights reflecting off road signs."

At about the same time, Red Cross pilots operating into an airfield in kwaZulu Natal at night noticed that nearby road signs were reflecting the aircraft's lights.

Gavin Brown could hardly contain his impatience to get back to Durban and experiment with the reflective paint or material used for road signs. Weeks of further frustration followed as reflector units of different sizes were placed alongside the runway at Virginia at a wide variety of angles. All this was done when the airport was quiet and with the full cooperation of air traffic control and the airport management, a safety officer and an official CAA observer to check the infrastructure.

vision, in some cases only picking up the sign at a distance of 75 m if the vehicle's headlights were positioned low down.

It was Durban-based Red Cross pilot, Dave Solomon, who came up with the possible solution after further flight tests confirmed that the degree of reflection depended on the angle of approach of an aircraft.

"Instead of having a flat reflective surface, why not curve the surface?" he reasoned. At about the same time as the tests with a curved surface were proving successful, a major US-headquartered company with branches in South Africa, 3M, unveiled an entirely new reflective agent which it called "VIP Diamond Grade Reflective Foil".

Brown immediately adopted the product on the reflectors and this resulted in a quantum jump in visual range from the cockpit of an aircraft. The system was built up to potential production standard including the battery-powered green threshold and red runway end lights for the final tests, which came over three years following the launch of the project.

The cherry on the top is a reflective windsock which will also be part of the system. The windsock will be red at its head and green at its tail each pointing to the runway end lights of similar colour.

The final breakthrough came one night recently when tests were conducted at Virginia Airport using a Pilatus PC-12, a Piper Seneca and a Piper Tomahawk training aircraft. Despite the bright lights of nearby buildings and vehicles travelling on an adjoining freeway, the pilots of the test aircraft were all able to clearly pick up the runway threshold lights initially at a range of five kilometres and then the reflectors at 3,1 kilometres range.

On the same evening a Cessna Citation had landed with the pilot being unaware that the runway lights were, in fact, off and what he had seen were the reflectors. He had a stand-up argument with the safety officer about the matter, which unwittingly confirmed the system's effectiveness.

It was found that an aircraft needs two lights for the system to work effectively and also for safety. This could be either dual landing lights or one landing light and one taxi light. However, each bulb must be rated at a minimum of 100 watts.

Various angles of approach were tried, and all proved successful, thus rubberstamping the concept. The best angle is an approach of about four degrees.

SAFETY MEASURES

Gavin Brown told *World Airnews* that, although the system could be portable, it was preferable that it be a permanent fixture as the reflectors had to be mounted correctly to give the desired reflection intensity.

"This means that someone in authority must be present if an aircraft on an emergency flight is to make a landing at the airfield. Not only will he ensure that the reflectors and runway end lights are all in position, but at an out-of-the-way country airfield, he can also ensure that there are no animals or humans wandering across the runway," Brown said.

Although visual range was much improved using the road sign materials with pilots in the test aircraft now able to pick up the reflectors from about 900 metres, this was still not enough to satisfy the authorities, the pilots or, in fact, Brown himself.

He made a deeper study of the road signs and found that their reflective power varied for the driver according to the type of vehicle being driven. For example, the driver of a car could pick up a road sign from a considerable distance away, whereas the driver of a large truck sitting high up off the road, had a limited

A Red Cross Pilatus PC-12 ambulance aircraft is lined up on an unlit runway just before dark (left) as the crew waits for the passengers. After the patient is loaded aboard (below), the aircraft has to take off in the lights of cars, if they are available. The new emergency lighting system will greatly improve the safety aspect of these operations.

When questioned about the possibility of the reflectors and/or lights being vandalised, Brown said that this problem had also been carefully considered. "Stealing the reflectors or lights would be a total waste of time and effort. The thieves would get virtually nothing for them at a scrap metal dealer, and we are taking steps to ensure that they are protected by serial numbers and other methods," he said. "It would be about as pointless as stealing a road sign."

Brown received a South African patent for his invention last year and a world patent came through last month. He plans to begin producing the emergency lighting system on a large scale in Durban in the near future.

SPECIFICATIONS

Brown emphasised that the system had not been designed to replace electrical runway lights, but rather as a back-up for airfields that had runway lights which were subject to failure and theft, and in rural areas where, even if electrical power could be brought to the site, the cost would be enormous and, anyway, there was an extremely high probability that the lights and equipment would be stolen after they had been installed.

The system consists of six green portable threshold lights and six red runway end lights which are energized through an electrical inverter plugged into the cigarette lighter of a motor vehicle or connected directly to a car battery. The current drawn from the battery is extremely low. Provided the battery is in good condition, the lights can be energized for several hours without running the battery flat.

A series of double-sided reflector posts with a compound reflector face is positioned either as a permanent fixture or as a movable, along the edge of the runway. The reflector posts must, however, not be positioned at distances greater than 50 metre apart and must be positioned outside the edge of the runway.

With runways less that 18 metres wide the delineating system must be placed nine metres either side of the centreline. Runways 18 m and wider should have the delineating system placed a minimum of one metre outside of the prepared runway surface.

Reflectors that are used as a backup for existing runway lights, must be placed parallel to these lights, but outside the line of the lights. If aircraft such as gliders are utilising the airfield where these reflectors are permanently fixed, a minimum safe width of 30 metres (15 metres each side of the centreline) should be employed or the reflectors must be of the demountable type and removed during glider operations.

The reflector itself consists of a PVC stand, VIP Diamond Grade reflector film glued on a metal or non-metallic backing and bolted to the framework with anti-theft bolts to form a compound reflective curve.

The reflector plates have a two-degree horizontal angle towards the runway centreline. Care therefore must be taken to ensure the correct positioning of the reflector system is maintained when using the movable system. ✈