
Merlin™

detect & deter

Bird Control Radar Systems



1. Introduction & Company Overview.

DeTect, Inc. (DeTect), based in Panama City, Florida USA, specializes in development, engineering, manufacture, installation, operational integration, operation and support of advanced, innovative radar remote sensing technologies supporting a wide range of users and industries worldwide. The company's products include:

- **MERLIN™ Avian Radar Systems** (MERLIN), that are the most widely used bird radar technology in the world for operational aviation flight safety (aircraft-birdstrike avoidance) and for bird/bat mortality risk mitigation and control (at wind farms and industrial facilities) with over 70 systems currently operating worldwide;
- **HARRIER™ Security and Surveillance Radars** (HARRIER) for airspace, marine and ground surveillance and security; and,
- **RAPTOR™ Radar Wind Profilers** (RAPTOR) for weather, flight and military operations support, space launch support and severe storm forecasting.

Current users of DeTect radar technologies include the US Fish & Wildlife Service (USFWS), US Environmental Protection Agency (EPA), US Department of Agriculture Wildlife Services; US National Oceanic and Atmospheric Administration (NOAA), Transport Canada, the United Kingdom Department of Food and the Environment (fera, Bird Control Unit), military and space agencies (US Air Force [USAF], US National Aeronautical and Space Administration [NASA], US Navy, US Army, Indian Air Force, Kuwait Air Force), university research organizations, international engineering consultants, and various industries including wind farms, oil and gas facilities, oil tar sands facilities, potash processors and power plants.

DeTect is a fully integrated supplier, developing, designing, engineering, manufacturing, installing, integrating and supporting its products worldwide. The company has company-owned manufacturing plants in Panama City, Florida USA and Longmont (Denver), Colorado USA for its products with additional offices in Washington, DC; Canada, the United Kingdom and India.



Upper: DeTect Headquarters offices and manufacturing plant for MERLIN and HARRIER systems. Lower: MERLIN system assembly, testing and service area.



DeTect is the world leader in development, delivery, operation and support of real-time bird radar remote sensing and management technologies. DeTect's expert staff have led bird radar technology development achieving virtually every major industry 'first' as noted below:

- Dopplerized bird radar system (2010)
- Deployment of a bird radar system at an active forward war zone airbase (Bagram Airfield, Afghanistan 2010)
- Automated, tactical, real-time birdstrike risk alerting system in a commercial air traffic control tower (2009, Durban IAP, S. Africa)
- All weather solid-state bird radar system (2009)
- **Large scale automated industrial bird control radar system (Horizon Mine, Alberta, Canada 2009)**
- **Automated radar-based bird control radar system (PacifiCorp, Wyoming USA, 2007)**
- Automated birdstrike risk alerting system (2006, USAF)
- Bird radar system at commercial airport (2003, Augusta Regional)
- On-airfield bird detection radar for tactical use in military air traffic control tower (2003, RAF Kinloss, Scotland)
- Biological target detection algorithm for a weather radar (2001)
- Automatic vertical scanning radar for bird detection (2000)
- Large-scale fully automated bird strike risk management system (1999, AHAS, www.usahas.com, USAF)
- Airport bird avoidance model (1997, USAF)
- Computer birdstrike mission planning model for pilots (1996, USAF)
- Year-round remote sensing studies of bird activity (1995, USAF)



MERLIN bird radar system with MERLIN SCADA integrated with wind farm control system to automatically idle turbines when birds are detected approaching the wind farm under high mortality risk conditions.

DeTect additionally developed and currently operates the US Avian Hazard Advisory System for the USAF (AHAS, see www.usahas.com) that uses the US national weather radar network (NEXRAD WSR-88D sensors) to provide nationwide, continuous, real-time birdstrike risk hazard alerting to all US and allied military flying units for the continental U.S., Hawaii, Alaska, Guam and Korea. AHAS is the most advanced and largest bird detection radar network in the world and includes over 10 years of archived bird activity data for the continental US in a neural computer network housed and maintained in DeTect's Florida facility.

DeTect originally developed its MERLIN Avian Radar System to enhance AHAS for the USAF as a real-time bird detection, tracking and birdstrike risk alerting radar system for close-in airfield/airport birdstrike risk alerting, and, today, MERLIN is the only bird radar system being used for tactical, real-time birdstrike risk warnings to military and commercial air traffic controllers and pilots. ***MERLIN is also the only bird radar technology deployed and operating for real-time, automatic bird mortality risk mitigation and control at wind farms and at industrial plants, which includes the only such systems operating at oil tar sands facilities.***

DeTect's MERLIN system is mature, proven technology - ***the MERLIN detect & deter Bird Control Radar system proposed is production-model technology.*** Since 2003 the company has manufactured, delivered and supported over 70 of its MERLIN bird radars for projects and facilities located in Canada, the US, the United Kingdom, Europe, Africa and New Zealand that includes applications for bird detection and control for airports/airfields (bird-aircraft strike avoidance); wind energy farm avian risk assessment and mortality mitigation (MERLIN SCADA); migratory research and environmental management; and, landfill and industrial site bird detection and control (MERLIN *detect & deter*).

With MERLIN, users are getting much more than just a bird radar system - DeTect is uniquely qualified to support complex bird control and mortality risk mitigation with its specialized staff expertise and resources in bird control. DeTect's on-staff resources include a highly qualified staff of experts in bird and wildlife control, avian management planning, radar ornithology and bird/wildlife biology that ensures full, seamless integration of its MERLIN technology into each client user's site. Full time staff bird/wildlife management experts include the former Chief of the USAF BASH (Bird-Aircraft Strike Hazard) Team, the former Head of USAF Bird Control Europe, former USAF bird/wildlife control staff, former US Department of Agriculture Wildlife Services (USDA WS) bird/wildlife control experts, licensed falconers, US Federal Aviation Administration (FAA) Qualified Wildlife Biologists, and various licensed bird/wildlife pest control experts. DeTect's expert staff have provided bird and wildlife risk assessment, planning, bird radar and control services at over 200 project sites worldwide that includes delivery, installation and support of over 70 bird detection radar systems to date to sites worldwide in virtually every type of habitat and climate.

DeTect provides comprehensive support for MERLIN systems and all system deliveries include full installation, commissioning, integration, calibration, data analysis/reporting and other support to ensure that each system meets the specific operational needs of the customer. Additionally, all DeTect products include a comprehensive warranty the covers all labor, parts and other costs for on-site repair or

replacement of any components that fail within the warranty period. The company has a high level of repeat orders as well as regularly adds new customers to an already impressive customer list. DeTect routinely receives commendations for its level of service and quality:

Your work at the [Waste Management] Louisville landfill as one of the best executed bird control programs in the nation. Better than most USAF bases and commercial airports I have seen.

... Lt. Col. Edward L. Vaughan, USAF, Chief, Aviation Safety (NGB/SEF). Arlington, Virginia, USA

Excellent work. [the Wildlife] report covered all highlight topics and very precise. The statements on [wildlife] control activities are what needs to be transferred to quarterly reports.

... Kevin Mieczkowski, Facility Engineer, Waste Management LLC, Louisville, Kentucky, USA

Babcock & Brown Renewable Holdings Inc. [now Pattern Energy] has, since 2005, contracted with DeTect Inc. for equipment and services on projects in Texas and New York [added a California project in 2010 and Nevada project in 2011]. We are convinced that the MERLIN Avian Radar Survey methodology is the best on the market today. The level of service provided by Detect and the reliability of their equipment is very high.

... John Greiner, Permitting Manager, Babcock & Brown Renewable Holdings Inc. Houston, Texas USA

Your guys all did a fantastic job on the F-15 [bird-aircraft strike] mishap; truly outstanding! Thanks!

... Eugene LeBoeuf, Team Chief, USAF Bird-Aircraft Strike Hazard (BASH) Team, Air Force Safety Center, Kirtland AFB, New Mexico, USA

I know that the staff of Vancouver International Airport share my high regard for the DeTect team. We believe that the DeTect team is the only group capable of delivering the results that we seek.

... Bruce MacKinnon, Director of Security and Safety, Transport Canada, Canada

Meridian is extremely pleased with the MERLIN radar and we can clearly envisage that it will be a crucial tool in evaluating ecological issues for gaining wind farm consents,

... Marise Mettrick, Resource Monitoring, Meridian Energy Limited, Wellington, New Zealand

The DeTect MERLIN avian and bat monitoring system that we have installed on an island adjacent to our offshore wind energy demonstration project site has surpassed our expectations as to the depth of detail, digital processing, and data mining capabilities that we needed The DeTect team did you proud, and apparently caused a shift in the horizons of the regulators – particularly Fish and Wildlife – of what radar and software can do ... You've got a great system. Thank you DeTect and the whole team for going the extra mile to get this done.

... Michael Kujawa, Director Research and Analysis, Winergy Power [now Deepwater Wind], Hauppauge, New York, USA

Your [MERLIN Avian Radar] system worked like a champ and allowed us to launch the Space Shuttle Discovery safely July 4, 2006 on her STS 121 Mission to the International Space Station. Thank you very much.

... Mike Leinbach, NASA Launch Director, Space Shuttle Program, NASA Kennedy Space Center, Florida USA

2. MERLIN Bird Control Radar System.

Effective bird control over large areas has traditionally been a costly, labor intensive process. In response to industry needs, DeTect in 2006 developed the MERLIN *detect & deter* Bird Control Radar system (BCRS) as the solution. The MERLIN *detect & deter* BCRS was derived from and uses the same advanced, proven military-grade bird radar technology DeTect developed for the USAF in 2003 to reliably detect and track birds at ranges out to 4-6 miles, monitor user-defined control zones, and automatically activate bird deterrent devices to effectively deter and harass birds from entering restricted areas.

MERLIN's high level of automation and reliability, incorporated with the latest in advanced bird control technologies, provides effective bird control 24-7 for a wide range of industrial sites that include process/waste ponds, product storage areas, landfills, contaminated sites, and solar power plants. MERLIN *detect and deter* is highly customizable for each site and can be interfaced with a wide variety of bird deterrent devices to provide hazing responses specific to each user's operation, site characteristics and environmental management needs. This flexibility in design and performance as well as the system's scalable and expandable design is particularly critical to deployment at oil tar sand and other similar industrial sites due to the size of the areas to be covered and ongoing expansion of the site that will occur over the project's life.



The MERLIN *detect & deter* Bird Control Radar system at the CNRL Horizon Mine oil tar sands facility was the first large-scale, wide area, automated bird control radar system installation in the world and has proven very effective in reducing bird mortality.

2.1 Bird Detection Radar Technology.

The MERLIN *detect & deter* BCRS uses a custom-manufactured solid-state horizontally-scanning radar with advanced clutter suppression and Doppler processing to provide continuous, highly reliable monitoring, precision detection and accurate tracking of birds over large, complex, high clutter areas with bird detection operating ranges out to 4 miles and from near the ground level to over 10,000 feet in altitude. **MERLIN is the only bird radar system that uses advanced solid state Doppler radar technology** that provides higher detection sensitivity with lower radiated power density when compared to older technology bird radars that use commercial-off-the-shelf (COTS) magnetron-based marine

radars. Solid state represents the state-of-the-art in radar technology and the sensors used in MERLIN include DeTect's proprietary Bird Mode firmware to deliver the highest level of bird detection available.

MERLIN also operates in the 10 centimeter (cm) wavelength S-band frequency range (3050 MHz) that offers better detection over complex terrain and vegetative clutter (as well as over water) and delivers all-weather bird detection. Lower end 'bird radars' use X-band magnetron radars (9410 MHz frequency, 3 cm wavelength) which are highly susceptible to moisture and accordingly deliver poor bird detection in high vegetative environments, and are effectively 'blinded' in even light rain events (both resident and migrating birds will continue to fly during light to moderate rain events). The 3 cm X-band is also highly susceptible to "false positives" from insects, which further makes it less reliable for real-time operational use.

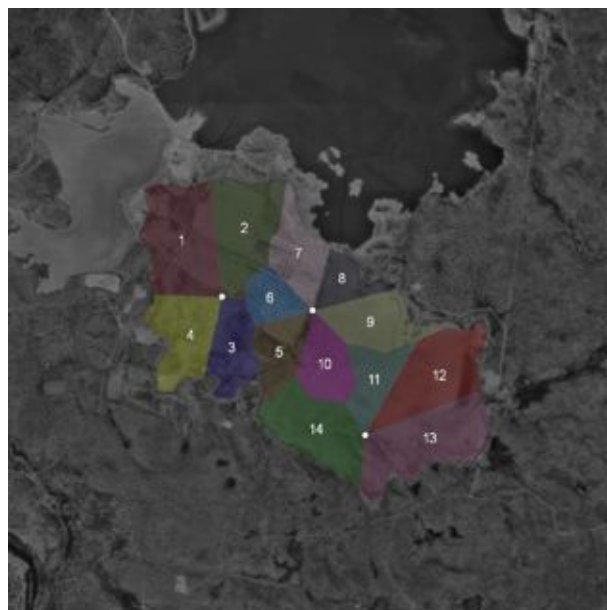
DeTect's low power density solid-state sensor at 200 watts (compared to 25,000 to 50,000 watts for X-band magnetron systems) also significantly reduces any risk of interference from the radar to other facility systems and *vice versa* as well as orders of magnitude safer for human exposure. DeTect's solid state radars also are the only Dopplerized bird radar on the market and are electronically variable in frequency to easily up or downshift within the frequency band for frequency deconfliction with other systems, if required (4 bands up and 4 bands down in 20 MHz increments) allowing multiple radars to be co-located without interference.



MERLIN is the only bird radar system that uses state-of-the-art solid state radars.

As noted above, the MERLIN *detect & deter* BCRS is based on DeTect's proven MERLIN Avian Radar System software and the MERLIN ATC (Air Traffic Control) automatic birdstrike risk alerting module that is relied upon by the USAF, NASA and commercial airports worldwide for real-time, critical flight safety support (bird-aircraft strike avoidance). In MERLIN, radar data is processed continuously and in real-time by DeTect's proprietary MERLIN Avian Radar System software with target, track and risk updates every 1.2-2.2 seconds (depending on the scan rate selected). **The MERLIN bird detection software was custom developed specifically for bird detection to identify and track the unique characteristics of bird targets** that exhibit irregular flight tracks and variable radar cross sections (a bird's RCS varies as the bird flaps its wings) which traditional ship or aircraft tracking radar algorithms are much less effective at identifying and tracking. The MERLIN bird detection and tracking software operates in real-time applying advanced, military grade target

identification, classification and tracking algorithms and clutter suppression and interference rejection routines to the radar data stream to provide superior, highly accurate identification and tracking of bird targets over aircraft/ship software or image processing based systems. **MERLIN additionally incorporates advanced dynamic, real-time ground clutter suppression and Doppler processing to more reliably detect and track birds in the high clutter environments** - a functionality that is unique to MERLIN and that is critical to delivery of an effective system for most complex industrial environments. The end result is that **MERLIN is the best available technology for bird detection and is the industry standard for aviation and environmental applications with more operating installations than all other so called bird radars combined.**



MERLIN detect & deter system LRAD control zones for automated industrial bird control at large salt evaporation ponds at a Potash plant near Carlsbad, New Mexico USA (customer: Mosaic Potash Carlsbad).

The accuracy and reliability of MERLIN for bird detection has been validated by various users that include the US space agency, NASA, which tested MERLIN and other bird radar systems in 2006, selecting MERLIN and certifying the MERLIN technology for operational bird detection support during space shuttle launches. NASA purchased two MERLIN systems that have been used on every space shuttle launch since the July 4, 2006 Return-to-Flight launch and **NASA will not launch the \$2 billion space shuttle without MERLIN system support.**

2.2 System Design & Configuration.

MERLIN *detect & deter* is highly flexible and custom programmable for each site. The system provides automatic activation of bird deterrents for unlimited control zones based on defined risk thresholds set for each site to humanely harass birds and prevent landing in restricted areas such as waste ponds and landfills. The MERLIN *detect & deter* technology supports an unlimited number of user definable control perimeters, areas/zones and deterrent devices within the MERLIN software and any bird targets detected approaching and/or entering the control area, will trigger activation of the deterrent devices.

MERLIN *detect & deter* has been developed as a modular system to support the ever changing and expanding requirements for industrial sites. **The MERLIN BCRS system is designed to ‘detect and deter’ birds while in flight BEFORE they land on or in the restricted area** and the deterrent devices are positioned and activated to ensure that the birds are ‘harassed’ until they are well outside of the control area(s) to deliver the highest level of bird protection.

A self-contained trailered or skid-mounted ‘master’ MERLIN bird detection radar unit acts as the central sensor and controller for the complete bird detection and control system, detecting and tracking bird targets, assessing risk instantaneously, and, based on the risk rules programmed into the system for the specific site, activating deterrent devices before birds contact the restricted area. The master MERLIN radar unit module is positioned at each site to provide full 360 degree, three dimensional (3D) surveillance of the airspace around the site to be controlled, detecting approaching bird movements from the ground level and up. The location of the radar sensor is identified by DeTect during the project design phase using advanced desktop coverage and terrain clutter modeling software which optimizes coverage and minimizes system start-up requirements by defining the radar operational settings prior to delivery, requiring only ‘fine tuning’ at commissioning. Secondary ‘deterrent modules’ consisting of trailer or skid unit modules with various deterrent devices are positioned around the control area to provide full hazing coverage of the control area and each device is assigned to a specific ‘haze zone’ within the MERLIN *detect & deter* software. Deterrent device ‘firing’ singly or in groups is activated through a series of custom controller units located at the master radar unit that provide the interface between the master MERLIN bird radar computer system and the satellite deterrent modules. These controller units support video, audio, Ethernet, serial, USB devices and can control virtually any compatible device with a wide variety of I/O modules for mix and match flexibility.



A Master MERLIN bird radar sensor unit provides 360 degree 3D bird detection and acts as the master controller for the overall MERLIN detect & deter system.



One or more Satellite Deterrent units with varied multiple zoned hazing devices are positioned to cover the control area and are remotely activated by the master radar unit through a fixed or wireless network. (MERLIN BCRS system installed at Mosaic Potash, Carlsbad, NM, USA)

The overall MERLIN detect & deter BCRS consisting of the master and satellite modules operates automatically and unattended and is fully remote controllable. In the rare instance that the master unit goes offline, the system will provide a failure warning to designated remote user site (options include on-screen and audible alerts, email, text messaging or pager) and the deterrent devices automatically default into a programmed randomized deterrent firing mode at each module until such time as the master unit is back online. With its programmable and modular design, MERLIN *detect & deter* is also scalable and expandable - at any time, the system can be reconfigured or expanded by adding radar or deterrent 'modules' to meet changing or expanding operational requirements of the facility.

2.3 Integrated Bird Control Technologies.

MERLIN *detect & deter* can remotely control and activate a wide range of industry standard, non-lethal bird harassment (hazing) devices including eye-safe lasers, propane cannons, effigies and directional and non-directional bioacoustics.

2.3.1 LRAD Bioacoustic Deterrents.

DeTect, in partnership with the LRAD Corporation (www.lradx.com), has developed a focused-beam, long range, directed bioacoustic system – the Long Range Acoustic Device (LRAD) - for bird control that are available only with the MERLIN system. The LRAD is a powerful, robust, low maintenance, military-grade focused beam acoustic stem that can direct deterrent sounds in a narrow beam (15 degrees) over extended effective ranges to over one-half of a mile and is the most widely used long range acoustic device in use. The LRAD was originally developed for the US Navy and is currently used widely for non-lethal force protection, public address and crowd control. LRAD unit is a compact, focused planar speaker array that can project a variable intensity (up to 120 dB) at ranges out to ½ to 1 mile with a highly focused beam with minimal spillover to non-control areas. LRAD can transmit verbal commands as well as digital recordings (.wav or mp3 formats) and can be used in manual or automatic, radar-directed modes.



LRAD bioacoustic deterrent units installed onto the master MERLIN radar unit trailer and positions to cover control zones. Note: a DeTect laser deterrent unit (LDU) is also mounted on the support stand.

The LRAD is also the most powerful and widely used long-range acoustic system on the market and has a record of proven, superior performance over similar design ‘knock-off’ systems in comparison tests by both DeTect and various military users. With each MERLIN *detect & deter* BCRS, DeTect supplies a complete library of recorded bird distress calls and other nuisance sounds (gun shots, cannon shots, sirens, etc.; the bird distress calls supplied are specific to the region).

The LRAD technology is key to effective control of bird at large facilities as conventional bird control devices (propane cannons, omni-directional bioacoustics and effigies) have only limited effective ranges (less than 100-200 feet at best). This limited ability of these conventional bird hazing devices to effectively deter birds at distance from the ‘shore’ on the large ponds that are common at large industrial sites require their placement on barges in the pond which are difficult and expensive to access and maintain. In many cases, LRAD units can provide effective control beyond the center of the pond solely from shore-based locations. The specific layout and coverage for each MERLIN *detect & deter* BCRS implementation is custom designed by DeTect to deliver maximum bird deterrence while minimizing noise exposure to workers in the area as well as nuisance noise spillover to surrounding areas (plant areas, adjacent businesses, residential neighborhoods, etc.).

For effective bird control, multiple deterrent components are required for an effective bird control system to prevent habituation and ensure wide species response. For large area bird control, the LRAD device offers the best available technology and in the MERLIN *detect & deter* BCRS acts as the primary control device with secondary and tertiary deterrence provided additional technologies as described below.

2.3.2 Laser Deterrents.

With the MERLIN *detect & deter* system, DeTect also incorporates a DeTect manufactured, programmable, broad beam bird control Laser Deterrent Unit or LDU. The DeTect LDU is a green laser for low visibility conditions that is elevated for local worker safety and works in concert with the LRAD units as a secondary deterrent. The LDUs are integrated and controlled by the master MERLIN unit to deter birds primarily during night and low light conditions and can be operated as a sweeping laser to prevent birds from landing on water and shorelines. The laser systems manufactured by DeTect are robust, designed for adverse environments and all operating components are enclosed in weatherproof enclosures with no external moving parts exposed. The systems are additionally eye-safe and are positioned to reduce exposure risk to area workers.

2.3.3 Secondary Deterrents.

As supplemental deterrents and to fill coverage 'gaps', particularly along irregular shoreline areas, DeTect manufactures a Secondary Deterrent Unit (SDU) that is incorporated into the MERLIN BCRS. The SDU includes the ScareWars® remotely controlled, solar/wind powered propane cannon/omni-directional bioacoustic package with a DeTect manufactured 'pop-up' effigy on a compact ATV-type trailer to support quick repositioning as needed.



DeTect Secondary Deterrent Unit propane cannon/ bioacoustic/effigy ATV unit.

ScareWars is a product of the Reed-Joseph Company (www.reedjoseph.com) and is ruggedized, industrial grade unit widely used by DeTect's military customers worldwide. DeTect staff have worked in partnership with Reed-Joseph on bird control programs since the late 1990's. The SDUs at industrial site are used for specific area control due to limited range of effectiveness, and can directly controlled and activated by the MERLIN unit or as standalone units. The SDUs also include portable manually operated controllers to allow manual firing or firing via preprogrammed, randomized schedules.

2.4 BCRS Configuration & Operation.

MERLIN *detect & deter* systems are delivered in fully self-contained and self-supported, mobile trailer or skid mounted modules with the number of modules and layout determined by the size and layout of site(s) to be protected. Each module is individually self-contained and powered and includes all ancillary components such as on-board power system (generator, solar, etc.) and support equipment for a complete "plug-and-play" system that is operable at delivery. The MERLIN radar sensor is the 'master' unit and consists of a trailer (or skid) platform with the radar sensor, extendable radar tower, equipment enclosure with Technician console/desk vibration dampered, rack mounted master system electronics (MERLIN system computers, MERLIN SQL Datasystem, remote control panel, GPS/Compass, uninterruptible power supplies [UPSs, for up to 3 hours battery operation], monitors and ancillary components), dual environmental system (HVAC units), and power system (dual diesel genset with power controller and on-board diesel fuel tank to support up to 500 hours between service intervals). The

system will also operate on commercial power (110/220 vAC, 60/30 amp service or country standard) and is supplied standard with an external power plug and 50 feet of cable.

The system's power controller will automatically switch the system to generator power in the event that commercial power fails or if operated on generator power, will automatically switch from the primary generator to the secondary unit after 250 hours of operation (the generator maintenance schedule requires oil and filter change at 250 hours which is approx every 10 days). The satellite modules are similarly trailer or skid mounted and fully self-contained and supporting however with the equipment installed in dust and waterproof NEMA-X outdoor rated enclosures with dual 'backpack' HVAC units. When installed, the master and satellite modules are positioned at the control site to provide the required coverage with the deterrents set by zone (as per the design plan).

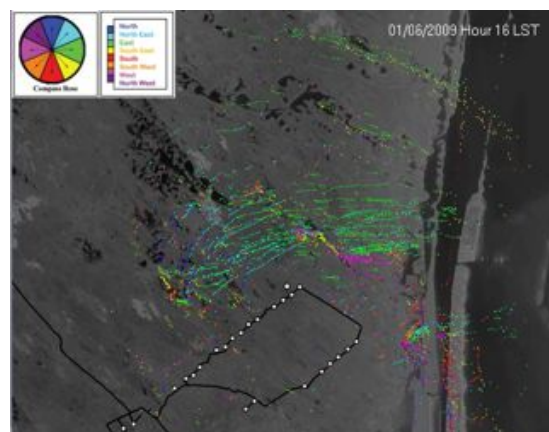
The modules are connected into a single network using the facilities existing copper, fiber optic or WWAN network (if available) and in lieu of an existing network or restrictions on use, a direct line-of-sight wireless network can be supplied. DeTect has extensive experience in designing, configuring and integrating these networks at military, commercial aviation and industrial sites and can provide a system meeting approved or available bands. For the CNRL Horizon Mine oil sands facility MERLIN *detect & deter* installation, DeTect supplied a XPress Ethernet Bridge for the system network and no conflict issues were or have been reported. The system is designed for industrial use and operates in the 900 MHz license free ISM band and supports a 1.5 Mbps RF data rate. Alternate systems can be provided if required for frequency deconfliction and a full spectrum review is included.

The MERLIN *detect & deter* BCRS operates with the main radar unit providing advance detection of birds as they approach the controlled areas perimeters, automatically activating the LRAD zones before bird(s) enter or traverse the zone(s) with adjacent zones will also "firing" as needed to ensure that the bird(s) do not enter or leave the restricted areas. The integrated weather system will also monitor environmental conditions to provide secondary deterrence with the laser units, especially in low light, darkness and low visibility (fog) conditions. For operational safety and nuisance noise control, all deterrents in the system are directed outwards from facility areas into unoccupied areas where possible. Additionally, the system will be calibrated using noise dosimetry equipment to minimize noise exposure levels within the control areas however hearing protection may be needed by workers when in the area for full protection. Similarly, the laser systems will be programmed and positioned to ensure that personnel exposure is restricted. The systems proposed use eye-safe green lasers and complete safety training and procedures will be provided by DeTect during system start-up.

After delivery and start-up of the system, DeTect biologists and radar technicians will remain on site into the first season to provide system validation and optimize radar detection tuning and deterrent responses. DeTect biologists and radar technicians will additionally be present at the start of the second season to assist facility personnel in system restart and to verify response in fall conditions. DeTect staff will also be on site at the end of the first full year to assist facility staff in securing and storing the equipment for the winter.

2.4.1 MERLINSQL Datasystem.

While the MERLIN detect & deter system primary function is to provide effective bird control in real-time, it also includes reporting and data archiving features. During system operation, system data is continually written to an internal data system, MERLINSQL to support regulatory reporting, trend analysis, and documentation. The MERLINSQL Server continually ingests all data into a SQL database to support standard and custom queries and reporting via web or network interfaces for graphing, statistical analysis and formatting. MERLINSQL incorporates



MERLINSQL supports a wide range of data reporting formats for each user application.

MERLINReporter which is a suite of radar data analysis and reporting applications and include MERLINReporter, MERLIN Trackplot™, MERLIN Mask™, MERLINChart™, and a Geographic Information System (GIS) Visualizer that allows playback of system data. MERLINReporter also includes an AutoReport generator that automatically processes data for each 24 hours period and sends a set of standard reports in Adobe PDF format to the client user to support day-to-day bird control program management. The daily automatic reports are for each user but generally include graphic and tabular presentation of the bird count by size by hour of day, bird count by altitude by period of the day, total bird count by size class, cumulative directional bird plot by hour of the day, and deterrent activations by zone and type.

As part of the project design, DeTect will consult with the client owner to define the reporting and recordkeeping required by the system. DeTect will also provide analysis and reporting of data monthly for the first year after delivery. The report format will be developed in consultation with the client.

2.4.2 System Design & Construction.

MERLIN systems are designed, engineered and constructed utilizing rugged, field proven components and provide a reliable, easily maintained solution for bird detection and control. The solid state radar has a documented radar MTBF (mean time between failure) exceeding 50,000 hours and a MTTR (mean time to repair) of less than 1 hour. The module trailer or skid platform are manufactured by DeTect of marine grade structural aluminum and are designed for use over unimproved roads (is not a 'stock' painted carbon steel frame). The trailer frame structure exceed US Air Force ATTILA or equivalent structural certification to include US MIL-HDBK-1791 requirements of loading at 3 gravities (G) forward, 1.5 G aft, lateral, 2 G up and 4.5 G down load at the integrated trailer frame tie-down or lifting eyelet points. Trailer/skid decking is of Alumibrite diamond plate sheeting of minimum 3/8 inch thickness affixed to the frame by stainless steel fasteners. All structural surfaces and materials are of industrial grade marine grade aluminum or 304 stainless steel materials for durability and corrosion resistance and key structural components are polyester powder-coated (five year rated at 0 undercut and 0 blistering at 1000 hour per ASTM B117-90). All fasteners are stainless steel, 316 grade or better. If trailered, the system is built to country-of-delivery transportation requirements with dual off-road high clearance axles and torsion suspension (no leaf springs).

Power system protection includes line-interactive, network-grade line conditioning, Sine-wave output, lightning and surge protection, automatic self test, unattended shutdown, site wiring fault indication, alarms, and AVR boost and trim features. The system includes an automated power controller that, upon loss of commercial power, will automatically start and switch to generator power to maintain uninterrupted stable system operation; if the system operates on generator power, the controller unit will automatically switch from the primary generator to the backup unit at 250 hours to allow for generator service (oil



MERLIN systems are manufactured by DeTect of durable, corrosion resistant materials for long service life in adverse environments.



On-board dual diesel power system provides up to 500 hours of operation between generator service.

and filter change). The generator unit starter battery will be equipped with a solar trickle charger to maintain charge in the event that the system is shut down and will maintain idle power status to allow remote system cold startup. The power system is also a modular package mounted to the trailer to facilitate quick change out of gensets when required.

The MERLIN radar sensor is a custom manufactured solid state, low power density, Type approved, S-Band radar with Doppler and proprietary Bird Mode processing that is operable at variable frequencies from 2920MHz – 3080 MHz (8 available bands in 20 MHz steps). Transmission bands are capable of being configured during commissioning to prevent mutual interference between co-located radars and other facility systems. The solid state radar includes a low profile, wide beam (24 degree) open array antennas and Bird Mode firmware with full antenna tilt-up to provide maximum airspace coverage and reliable bird detection at near ground level as well as above flight altitudes.

DeTect highly recommends the S-band radar sensor for optimal bird detection performance, however a solid state X-band Doppler radar is available if S-band is not allowed due to telemetry issues.

Standard radar frequency specifications are as follows:

- S-band Frequency : 3050 MHz
- Electronically adjustable from 2930 to 3080 MHz in 20 MHz steps
- Automated, all weather detection and alerting of hazardous bird activity
- Antenna beam width: 1.9 degrees Horizontal, 24 Degrees vertical
- Full 24 degree scan volume tilt-up on horizontal
- Pulsed radar: 0.1, 5 and 33 microsecond pulse lengths
- Pulse Repetition Frequency: 2200 or 1200Hz
- Scan rate: 24 rpm standard, variable to 48 rpm
- Doppler processor
- Proprietary Bird Mode

The radar is installed onto a custom built, screw motor extendable tower constructed of powder coated marine grade aluminum mounted to the trailer frame and positioned to provide the required scanning pattern for optimal bird detection around the control site. Extension of the tower is by Safety lock, key actuated, motor driven screw jack unit assembly and the tower is self supporting and non-guyed. The



All electronic equipment is mounted in a environmentally controlled enclosures and vibration, rack mounted for portability and durability.

tower is easily retractable and stowable by one person and the entire system can be secured for transport in under 30 minutes.

The master unit environmentally controlled operator/equipment insulated cabin (8 x 6 x 6 ft, l x w x h) includes a window and coded (keypunch) door lockset and is constructed of 4 inch thickness, aluminum skinned, structural insulated panels (SIPs) in an aluminum channel frame that is affixed securely to the trailer frame with all joints fully sealed with ProFab industrial grade sealant. The MERLIN trailer cabin design has been wind load tested to 80 mph. The keypunch lockset is industrial outdoor standard with code settable by the user.

The enclosure houses all system electronics and includes a local technician console/display-control workstation/and desk constructed of powder coated aluminum. A separate, locking electrical service door is included to allow access to the back of the rack mounted electronics. The enclosure will also include lighting, electrical outlets to industry power standards with auxiliary, dedicated sockets. Additional safety equipment including fire extinguishers and first aid supplies will be mounted to the inside wall of the enclosure. All wiring will comply with national and local codes and will be in enclosed conduits.

The cabin enclosure is equipped with a wall mount, industrial grade 13,500 BTU air conditioning/heating unit with removable dust filters that will automatically maintain the interior of the enclosure within the defined equipment and operator temperature range (65 – 72 degrees F). One additional roof mount unit acts as backup providing supplemental and backup climate control as required. The climate control system is fully automatic and includes monitoring, control and failure alarm sensors. All system equipment is on-board and mounted in a vibration damped, computer rack to allow the system to be transported over improved roads and off-road without damage to the equipment. Radar junction boxes and other non-computer components are mounted on power coated aluminum panel(s) that are firmly affixed to the inside walls of the enclosure. The system includes all operating software including the MERLIN bird radar and *detect & deter* (MERLIN Haze) software operating on a Microsoft Windows OS (country of delivery version; foreign language versions of MERLIN and Windows are available as an option). The satellite modules are constructed to the same standard as the master radar unit, however the equipment is rack mounted into NEMA-X outdoor rated, sealed electronics cabinet (with front and rear access) with dual backpack HVAC units and a slide-out, folding rack monitor-keyboard-trackball mouse Technician display monitor.

MERLIN systems are constructed for operation in adverse and harsh environments with ambient operating temperature ranges from -20°C to +50°C and humidity up to 100%. Historically MERLIN systems have maintained operational availability of over 98% with overall system MTBF exceeding 10,000 hrs and a Mean Time To Repair (MTTR) of under two (2) hours.

3.0 Project References

The following are representative projects that demonstrate DeTect's experience, capabilities and resources:

Canadian Natural Resources Ltd (CNRL), Horizon Mine, MERLIN S200 detect & deter Bird Control Radar System, Fort McMurray, Alberta, Canada - Large scale, multi-radar and deterrent module bird control radar system for large tailings pond at oil tar sands processing facility in northern Alberta, Canada installed in March 2009 and operating since April 1, 2009. The system includes redundant state-of-the-art solid state master S-band radar sensors with 16 radar activated Long Range Acoustic Device (LRAD 1000X) zones and four programmable laser deterrent device zones to deter birds from the defined control area on four total, repositionable bird control trailer units (two master and two satellite). In January 2011, CNRL ordered two additional satellite modules to expand the system coverage. The site represents the first, and at present, the largest automated bird deterrent system installation in the world. The system has operated for four migratory seasons with deterrence rates exceeding specification requirements. DeTect provides staff for system demobilization at the end of the fall migratory season (equipment is removed and stored for winter) and redeployment prior to each spring migratory season (March); system operates through the spring, summer and fall each year. Contact: Richard Kavanagh, CNRL Horizon Mine, Ft. McMurray, AB, USA, email richard.kavanagh@cnrl.com



CNRL Horizon Mine master MERLIN radar unit #1, Fort McMurray, AB, Canada.



CNRL MERLIN detect & deter system, satellite trailer unit #02, Fort McMurray, AB, Canada

Mosaic Potash Ltd, Carlsbad, New Mexico, USA, MERLIN S200 detect & deter Bird Control Radar System, Mosaic Potash,

Carlsbad, New Mexico USA - Large scale, single master MERLIN S-band sensor with two satellite deterrent platform trailers for Potash mine and processing plant near Carlsbad, New Mexico USA installed to address migratory bird mortality from exposure to salt in product evaporation ponds. The system includes a state-of-the-art solid state radar sensor master unit with radar activated 14 Long Range Acoustic Device (LRAD 100X) zones and six programmable laser deterrent device zones to deter birds from the defined control area with a total of three, repositionable bird control trailer units to support changing evaporation pond usage. The system operates year-round on generator power and supply included delivery of three truck/boat mounted LRAD units (LRAD 100X) and annual reporting. Contact: Melody Russo, Environmental Manager, Mosaic Potash Carlsbad, Carlsbad, NM, USA, email melody.russo@mosaicco.com



Mosaic MERLIN detect & deter system master radar unit, Carlsbad, NM, USA.

Encana Middle Fork Gas Processing Plant, MERLIN SS200 detect & deter Bird Control System,

Parachute, Colorado USA - Skid mounted system consisting of a 200w solid state S-band MERLIN bird radar sensor with one integrated fixed LRAD 500X radar-directed bioacoustic bird hazing unit. The system detects and tracks migratory and resident bird activity as it approaches the site along valley approaches and automatically activates the bioacoustic deterrent to prevent bird from landing on the petrochemical waste pond. Special features include full remote system monitoring and automatic LEL detection and system shutdown in the event of high explosive vapor conditions. Contact: Kevin McDowell, Project Engineer, Encana Oil & Gas, Denver CO, USA, email kevin.mcdowell@encana.com



MERLIN SS200 detect & deter skid unit at Encana Middle Fork plant, Parachute, CO, USA.

PacifiCorp Jim Bridger Power Plant, MERLIN detect & deter Bird Control Radar system, Cheyenne, Wyoming, USA

The Jim Bridger facility is a coal-fired power plant located in Southwest Wyoming serving six Western states. DeTect was contracted to deliver, install, start-up and support a MERLIN X10 detect & deter bird hazing radar system. The bird management system was installed in April 2006 as an add-on to automate the existing speaker system installed around the pond and operates 24-7 detecting birds as they approach the ponds, automatically playing deterrent

sounds to humanely prevent the birds from landing in the exclusion zones. The system includes a horizontally-operating X10 surveillance radar controlled by DeTect's proprietary MERLIN™ radar signal processing software with DeTect's deterrence control software module (detect & deter) that automatically activates electronic acoustic bird hazing devices installed around the ponds when birds are detected and tracked by the system on a course to enter the controlled areas. Contact: Roger Warner, Compliance Engineer, PacifiCorp, Cheyenne, WY, USA, email roger.warner@pacificorp.com



MERLIN X10 detect & deter Bird Control Radar system, PacifiCorp Jim Bridger, Cheyenne, WY USA.

US Air Force MERLIN Aircraft Birdstrike Avoidance Radar Systems, US Air Force Continental and overseas airbases

– Since 2003, DeTect has supplied and currently supports seven MERLIN systems used by the USAF for real-time birdstrike risk detection and warning at six US bases and ranges. The seventh system - first m-series (military) MERLIN bird radar system - was installed at Bagram Airfield, Afghanistan to support coalition forces flight safety. The 2009, all solid state S-band, all weather bird detection model system includes special hardening and construction to maintain highly reliable performance in adverse environments and includes a heavy duty frame with high clearance off-road axles, Kevlar reinforcing armoring, sand filters, dual diesel generator power system with auto switching, redundant electronics and MILSPEC level design and components. This MERLIN system is the first deployment of a bird radar system to an active



MERLIN SS200m Aircraft Birdstrike Avoidance Radar system installation at Bagram Airfield, Afghanistan (May 2010). This is the 7th MERLIN system purchased by the USAF and the 1st to be deployed in an active war zone.

war zone and use includes real-time display in the air traffic control tower with automated alerting of birdstrike risk and was delivered by C-17 Globemaster airlift. Contact: Eugene LeBoeuf, Chief USAF BASH Team, Kirtland AFB, New Mexico USA email Eugene.LeBoeuf@kirtland.af.mil

Pattern Energy Corp, Gulf Wind I Wind Farm MERLIN SCADA Avian Mortality Risk Mitigation System, Kenedy County, Texas USA – Trailered MERLIN

XS2530e Avian Radar System purchased by the Australian based developer, Babcock & Brown (now Pattern Energy), and installed in 2006 for pre-construction of the remote coastal wind farm in south Texas. The system initially operated over 2 years collecting 24 hour data for preconstruction risk assessment - the largest avian radar dataset on any wind farm site in North America. During the pre-construction phase, the system operated on generator power and was remotely administered by DeTect for 29 months. In late 2008, the system was upgraded to the MERLIN SCADA system and



MERLIN avian radar system installed at the Gulf Wind I wind farm in Texas with MERLIN SCADA that allows the radar system to idle turbines when high bird mortality risk conditions are detected.

installed at the operating wind farm as a migratory bird mortality risk mitigation system - the first implementation of radar technology for real-time bird mortality risk mitigation in the world. In this configuration, the MERLIN system acts as an "early warning radar" detecting approaching migratory bird activity, assessing mortality risk conditions, and, if warranted, automatically idling selected or all turbines to reduce bird mortality risk, restarting the turbines once the risk conditions abate. Pattern Energy has purchased three MERLIN system to date with the latest scheduled to be delivered to a proposed wind farm site in California in mid-2010. Contact: Rick Greiner, Permitting Manager, Pattern Energy, Houston, TX, USA email rick.greiner@patternenergy.com

National Aeronautical and Space Administration (NASA), Avian Awareness Device, NASA Kennedy Space Center, Florida, USA - DeTect manufactured and delivered two expanded capability MERLIN Avian Radar Systems to the U.S. Space Agency, NASA, that are used to provide detection and tracking of hazardous vulture activity during Space Shuttle launches. The space shuttle main rocket struck a vulture during launch in 2005 and, while the bird did not hit the orbiter, NASA concluded that significant damage risk existing and required a detection system before future launches could proceed. The MERLIN system technology was selected based on its reliability and ability to detect bird targets in high clutter environments by NASA after extensive evaluation and on-site testing of available technologies that included testing of the Accipiter bird radar.

The MERLIN systems, which included specialized safety features and radiation shielding, were certified by NASA for operational use in 2006 and have provided detection and tracking for all shuttle launches since NASA's return to flight on July 4, 2006. DeTect additionally provides an on-site operational support team to NASA for each launch of the space shuttle and well as bird control consulting support. Contact: Andy Knutson, NASA Test Director, Kennedy Space Center, FL, USA, email andrew.d.knutson@nasa.gov



NASA MERLIN Avian Awareness Devices deployed for space shuttle launch monitoring.

*FOR ADDITIONAL INFORMATION
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