The Department of Energy National Nuclear Security Administration (DOE/NNSA) responds to federal, state, and local requests in accordance with the provisions of the nuclear/radiological incident annex (NRIA) to the national response framework (NRF). The DOE/NNSA led federal radiological monitoring and assessment centre (FRMAC) ‘is responsible for coordinating all (federal off site) environmental radiological monitoring, sampling, and assessment activities for the response.’ The aerial measuring system (AMS) programme is an NNSA element that contributes to the FRMAC as a vital monitoring asset. The mission of AMS is to characterise ground-deposited radioactive materials from aerial platforms. These platforms include fixed wing and rotary wing aircraft equipped with specialised systems for the detection of radiological materials that provide measurements in real-time. AMS was formally established in 1967 as an emergency capability and responded to nuclear incidents such as Three Mile Island unit 2 (TMI-2) reactor partial meltdown on 28 March 1979.

The roots of AMS, however, can be traced back to the previous decade, when aerial measurements were used in support of nuclear testing under the US Atomic Energy Commission at the Nevada national security site (NNSS), formerly known as the Nevada test site. In the 1950s, AMS also made its first international response in support of Operation...
Morning Light, the first phase of the search for the nuclear powered Soviet satellite that accidentally re-entered the Earth’s atmosphere over northern Canada early on 24 January 1978.

Current AMS assets, which include scientists, technicians, pilots, and ground support personnel, are based at the Nellis air force base in Las Vegas, Nevada, and at joint base Andrews outside Washington, DC. Both teams operate a fleet of Bell 412 helicopters and King Air B200 aircraft, which remain in a constant state of readiness in support of a radiological emergency which could occur at any time. Additional aerial measurement capabilities are available from the Savannah river site via fixed wing aircraft from US customs and border protection (CBP) and helicopters from the Savannah river site.

To remain current in their skill sets, AMS scientists and flight crews, alike, participate in quarterly proficiency flights and numerous exercises throughout the year, in addition to responding to real world emergencies. In 2005 AMS support was requested to check the location of large radiation sources in hospitals and industrial facilities after the demolition of the levee in New Orleans following hurricane Katrina. More recently, AMS responded in 2011 when the Tyhoku earthquake and resulting tsunami damaged the Fukushima nuclear power plant and surrounding areas. AMS teams provided wide-area contamination monitoring in order to assess radiation levels on the ground.

AMS has accumulated a vast body of knowledge and experience over 40 years of emergency response operations and for many years was the only game in town. Following the 11 September 2001 terrorist attacks and resulting concern about potential weapons of mass destruction (WMD) usage by terrorist organisations, an increasing number of local, state, and federal entities are now entering the radiological and nuclear aerial detection arena.

Since local emergency responders will most probably be the first on scene at a radiological incident, local and state agencies that can deploy aerial radiation detection assets during an emergency and know how to use them have the potential to save lives as well as supporting a seamless unified response. Increased availability of commercial radiation detection equipment optimised for mounting on aircraft has made establishing and maintaining aerial capabilities much easier than in the past. Most law enforcement agencies and fire departments already possess modern radiation detection equipment. However, these agencies still require specialist training tailored to the unique

I love the smell of caesium in the morning! © DOE
challenges of aerial radiation detection in order to become fully capable radiation detection assets.

MARS
In 2007, US DOE/NNSA and the Department of Homeland Security's Domestic Nuclear Detection Office (DNDO) created the AMS reach-back centre to provide training and assistance on all aspects of aerial measurement. The centre operated by AMS personnel from the DOE remote sensing laboratory at Nellis air force base was created to assist local, state and federal agencies in developing the skills, resources, technical reach-back and analysis capability, and training needed to conduct a successful regional aerial measurements operation.

Providing operational aerial measurement training is one of the reach-back centre's more important missions. For this purpose, mobile aerial radiological surveillance (MARS) training was established. The initial concept for MARS training arose from collaboration between AMS, DOE's radiological assistance programme (RAP) region 5 from Argonne national laboratory, and the Chicago police department.

MARS training seeks to expand upon the training provided by the radiation detection system manufacturer by focusing on flight operations: mission planning, selecting flight patterns, and making determinations on factors controlling acquisition sensitivities, data interpretation and data analysis. A MARS course typically takes three days, with a combination of classroom and practical exercises. The training includes whole day flights where students operate their own systems on their own aircraft with AMS advisors flying alongside. There are opportunities to fly over real radiation sources as provided by DOE regional assets, and practice the real time radiation anomaly localisation and identification capabilities as provided by the acquisition system.

Since it was established in 2008, more than 150 local responders have undergone MARS training. The training has been presented to many local jurisdictions that already possess robust preventative radiological / nuclear detection programmes, including Chicago, New York, Washington, DC, Los Angeles, Las Vegas, and Suffolk County, NY.

To assist emergency responders involved in aerial radiological missions with data analysis and interpretation, responders can upload radiation data files collected during their missions. DOE AMS scientists and data analysts then process and develop these map products which can then be downloaded by responders to support public safety and other critical decisions.

WINGS
The DOE's AMS programme and the Federal Emergency Management Agency's (FEMA) nuclear emergency response team (NIERT) programme have collaborated over integrating the capabilities of local, state, and federal assets into a collective aerial radiological response through a series of exercises named WINGS. These exercises comprise tabletops and field drills to aid in effective collaboration using aerial radiation data from multiple detection assets.

During WINGS exercises, participants have an opportunity to improve their aerial emergency response techniques and establish working relationships with other key agencies while proceeding towards seamless integration between all assets. The first real time interagency radiological response exercise for aerial assets took place during the week of 24 March 2014 at NNSS with more than 100 participants and seven participating aircraft.

On the morning of Monday 24 March 2014, the participating agencies arrived at north Las Vegas airport to register for the WINGS 2014 interoperability drill. They included NNSA, FEMA, DOE AMS, the ARMOR division of Las Vegas metropolitan police department, Los Angeles sheriff's department, US customs and border protection - Jacksonville, Florida, radiological assistance programme region 3 Savannah river national laboratory (DOE), the national technical nuclear forensics ground collections task force (NTNF GCTF) ARDIMS, the FBI, Pacific northwest national laboratory (PNNL), and the French Commissariat à l'énergie atomique. Local, state, and federal government agencies with aerial radiation detection capabilities could either attend a tabletop relevant to the WINGS event or the MARS refresher covering standard AMS flight operations.

The field portion of the event was carried out at the NNSS from Tuesday 25 March through Thursday 27 March. A combination of 20 scientists, pilots, and observers from outside agencies attended a one-day condensed version of the MARS course. This refresher covered the DOE's role during a nuclear or radiological incident, operational airborne radiation detection and assets, mission planning and data handling. Players refreshed their radiation detection techniques and prepared for the planning and execution of their flights at the NNSS during the drill.

Attendees for the tabletop walked through a radiation dispersal device (RDD) scenario said to have taken place at the NNSS, from the point of view of their various agencies. Through collaborative dialogue, the tabletop prepared the participants for the execution portion of the drill and enabled them to get to know one another. The tabletop also uncovered some important additions and changes that needed to be incorporated into current procedures in order to respond effectively to a nuclear incident involving multiple aerial assets. The majority of these findings were integrated into the drill that same week. All players together with local news broadcasters arrived at the Defense Research Agency (DRA) early on the morning of Tuesday 25 March to attend and kick off the drill. In addition to local news media several groups of VIPs attended next day to see how the response was unfolding. These visitors observed responders in action and asked controllers about the design of the drill.

Once initial briefings were completed, the players and representatives from each flight crew
prepared their flight patterns and briefed the AMS technical and aviation authorities on their plans before receiving approval to fly. Missions were then flown over most of 1,360sq mi (approx.) of desert and mountainous terrain at the NNSS as well as a large radioactive source located in a hospital parking lot in Las Vegas. Each aircraft was scheduled to fly a minimum of two flights per day and up to three aircraft were allowed in the NNSS airspace concurrently. On return from each assigned mission, the flight crew would deliver the radiological mapping data they had collected to the data analyst and begin planning for their next mission(s).

A delegate from each flight crew briefed the other WINGS participants each morning on what their crew had covered during the previous day’s mission, explained why they chose their specific flight pattern(s), and displayed the preliminary results provided by the AMS data analyst. After the results were discussed, the players were updated on the status of the scenario incident and further assignment requests were given to the air crews. Before the exercise closed, players were able to provide feedback on their experiences in the WINGS 2014 interoperability drill. The overall consensus was that the drill was a success. This was primarily because it had been possible to collect radiological data over actual distributed radiation sources not readily available to all aerial assets, but also because of the opportunity to establish working relationships with other assets having a common mission.

The next WINGS event is scheduled to run concurrently with the southern exposure field exercise at the HB Robinson nuclear generating station in South Carolina in July 2015 and will seek to build on the experience and lessons of the first exercise.

CONCLUSIONS

Aerial radiological measurement can provide valuable information about the radiation in the environment. The benefits of this include the ability to:

– Cover large areas efficiently
– Cover areas not accessible by vehicles or personnel
– Provide public safety information quickly in response to a radiological event
– Provide public health information for site remediation and support the return of an area to established levels
– Locate anomalies
– Minimise the resources needed for ground-based mapping.

The success of aerial measurement depends upon many factors and requires careful planning and thorough execution by experienced professionals. Success can be increased with ongoing training and exercises for the flight crews, equipment operators and science professionals. There are many variables that can influence data collection and impact the overall mission.

Over the past 50 years, NNSA’s AMS programme has conducted over 500 surveys in the US and abroad with the applications ranging from city background surveys to nuclear reactor accidents. Beside this, AMS has also trained others on the proper use and collection of aerial radiological data.

The next Wings exercise will be in South Carolina in July 2015 ©DOE