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**RADIOMETRIC FLIGHT TRIALS IN
THE FORTH ESTUARY ON 7/8/91.**

D.C.W. SANDERSON, A.N. TYLER AND K.J. CAIRNS.

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1. Introduction.

A brief radiometric flight trial was undertaken on 7th August 1991, essentially to prove a new gamma spectrometry installation. A twin engined helicopter operated by Dollar helicopters out of Cumbernauld Airport was used for the exercise. The new equipment under test comprised (i) a spectrometer mounting plate manufactured by Dollar to take SURRC equipment for rapid deployment, (ii) a 19" rack mounted spectrometer incorporating proven SURRC components, but with additional duplex inverter based UPS, and (iii) a Navstar XR4 GPS system with aircraft patch type aerial. The flight trial was conducted in the Forth Estuary area focussing on three small sites of incidental interest.

2. Equipment installation and performance.

The new installation has been constructed by Dollar with the dual aims of facilitating rapid deployment and satisfying CAA approval. The equipment is mounted via antivibration mounts on a fibre-lam board. The board is rigidly coupled to the airframe at hard points, and has satisfied stress analyses by a high safety margin. The detector is mounted on two rails using quick release pins. In the present configuration either SURRC 8 litre or 16 litre packs can be used. The 19" electronics rack is bolted onto four anti-vibration mounts.

Installation of crystal was straightforward and rapid, although minor detailed changes were noted to the board-helicopter mounting bolts. The electronics rack bolted down satisfactorily, although construction of stand-off feet and relocation to the n/s edge of the board would improve installation times and access considerably. These detailed changes have been noted.

Cabin space is considerably reduced with this installation - to the extent that only one observer can be carried in the aircraft rear compartment. A modification was discussed whereby the electronics rack would be rail mounted above the detectors, thus allowing either a twin detector array with the same amount of cabin space or a single detector installation with twin rear seats retained.

The GPS antenna (Type DM N72-1-1 from Dorne & Margolin, Bohemia, NY) comprises a flat plate aerial with close coupled diecast mounted Navstar pre-amplifier. After initial experiments at ground level the front area of the helicopter was rejected due to masking of low angle satellites by the engine/gearbox cowling and rotor drive assemblies. Three more promising locations were identified (i) the top of the rear aerolon (which would mean relocating a red navigation light), (ii) the base of the rear fin (requiring minor panel modifications), and (iii) the extreme tail of the aircraft (which would interfere with a white navigation light). The second of these two options was implemented, and the cable threaded through the tail boom of the helicopter into the passenger compartment. The Navstar XR4 was able to lock on to satellites down to 15 degrees inclination, which was sufficient to retain fixed position throughout the flight. Calculated accuracy ranged from 12m to roughly 70 m during the flight - rapid changes in trajectory producing transitory reductions of

precision. The GPS performance was extremely encouraging overall.

The 19" rack mounted spectrometer was powered by a duplex inverter/ UPS system based on RS vehicle power adapters. This is a different system from that previously used. The 9 Ah batteries incorporated in this fixture have an endurance without recharge of roughly one hour. During flight they are recharged from the generator at 28 V dc. The spectrometer and computer worked well during the flight. ¹³⁷Cs resolution of 10.6% was maintained throughout, from a 16 litre array of four NaI scintillators. During the flight trial a poor fuse contact was exposed in the first inverter circuit. The faulty component has been replaced. A further power supply problem in the second inverter occurred later on in the trial resulting in component damage. This may possibly have been associated with noisy generators on the helicopter which was showing intermittent problems with one generator. The charging line fuse, rated at 8 A was blown. Power demands were transferred to the first inverter only which operated successfully throughout the planned flight. Actions to ensure full power supply function have been noted.

3. Flight Results.

The flight paths followed included areas around Longannet Power Station, Donibristle Bay and the Grangemouth Oil refinery, all of potential radiological interest for different reasons. In the first instance natural radioactivity may be enhanced in the ash components associated with coal fired power stations. There have been recent radium discoveries at Donibristle Bay associated with wartime and immediately post-war activities at a former Fleet Air-Arm base. The mudflats in front Grangemouth are of interest since no further progress has been reported in recovering a ¹³⁷Cs source lost in the 1987 hydrocracker plant explosion.

The trials resulted in a total of 442 gamma ray spectra recorded with altitude and navigational coordinates during 2.3 hours of flying. The files were stored archivally and summarised using program SUM1. Data were stripped and calibrated using the AERO109 programs (Ayrshire 1990 calibration values), and mapped using BNFAER14. Maps for ⁴⁰K, ²¹⁴Bi, ²⁰⁸Tl and Total gamma flux are shown in figures 1-4 respectively. Notable features are (i) an area of moderately enhanced ²¹⁴Bi and ²⁰⁸Tl activity in the vicinity of Longannet power station (ii) a similar but larger scale enhancement to the East of this site near and on Preston Island, (iii) that the three lines flown across Donibristle Bay do not show any significant ²¹⁴Bi enhancement, and (iv) that the Grangemouth mudflats did show a significantly enhanced gamma flux in the vicinity of the plant. Subsequent spectral examination however indicated that this latter signal was associated with ¹⁹²Ir probably in use for on-site radiography.

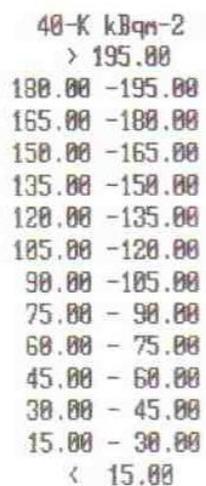
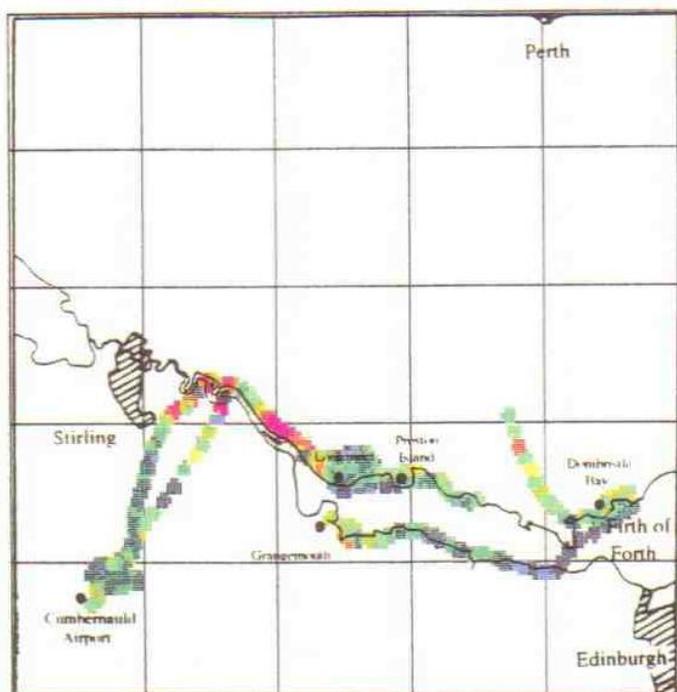
Caesium-137 levels were modest in comparison with the West coast. There was evidence of overstripping of ¹³⁷Cs and understripping of ¹³⁴Cs.

Further investigations of the Grangemouth area (periodically), and the Northern banks of the Forth would be of considerable interest.

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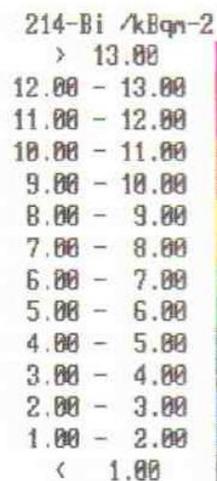
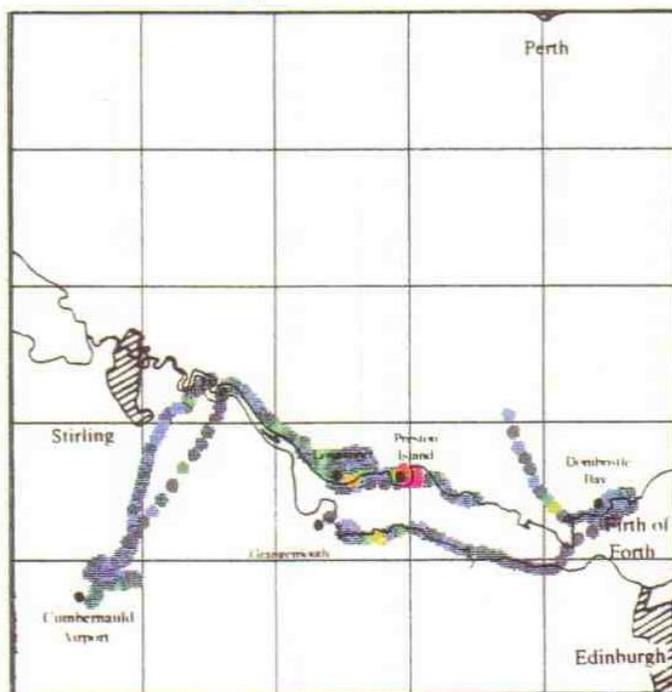
Forth Estuary 8/8/91



Scan screen

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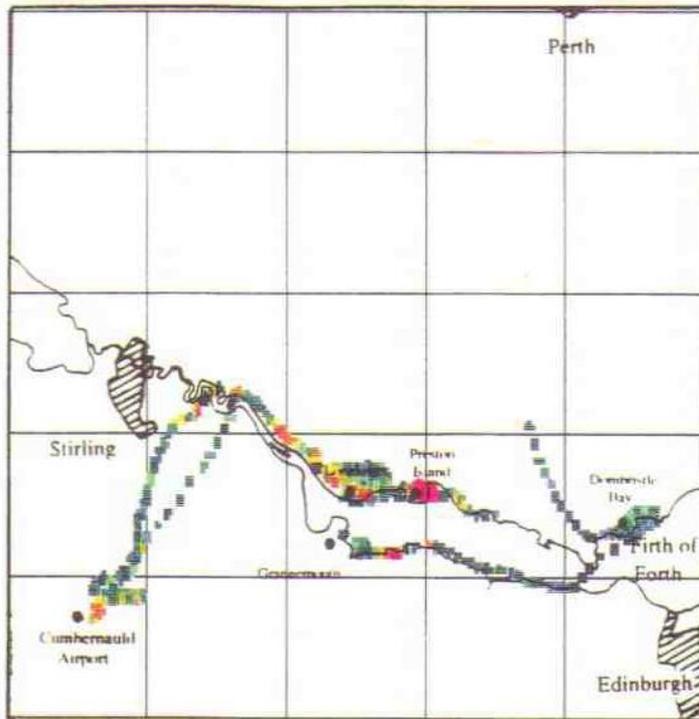
Forth Estuary 1991



Scan screen

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Forth Estuary 1991



208-Tl /kBq m⁻²

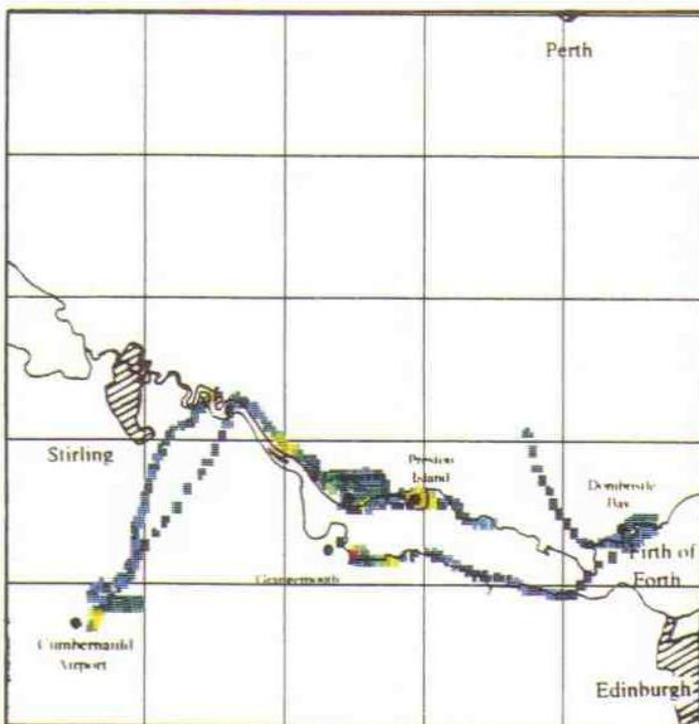
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- 6.00 - 6.50
- 5.50 - 6.00
- 5.00 - 5.50
- 4.50 - 5.00
- 4.00 - 4.50
- 3.50 - 4.00
- 3.00 - 3.50
- 2.50 - 3.00
- 2.00 - 2.50
- 1.50 - 2.00
- 1.00 - 1.50
- 0.50 - 1.00
- < 0.50



Scan screen

Origin: -300-300 Grid cell: 10 km File : \CAL\CMBD1.CL1

Forth Estuary 1991



>450 keV /cps

- > %1300
- %1200 - %1300
- %1100 - %1200
- %1000 - %1100
- 900.00 - %1000
- 800.00 - 900.00
- 700.00 - 800.00
- 600.00 - 700.00
- 500.00 - 600.00
- 400.00 - 500.00
- 300.00 - 400.00
- 200.00 - 300.00
- 100.00 - 200.00
- < 100.00



Scan screen

Origin: -300-300 Grid cell: 10 km File : \NET\CMBD1.NT1