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VIEWFOILS FOR ENVIRONMENTAL CAPABILITIES PRESENTATION

1) Introduction

First of three remote sensing technologies for DOE by EG&G
Original and key part of Aerial Measuring System (AMS)

2) Helicopter

AMS best known for helo surveys, also fixed wing.
Surveys map spatial distribution and concentration of Gamma emitting
radionuclides on ground from the air.

3) Applications

Search for radiation anomalies, Cs-137 concrete in Houston
Overview of large area, ore outcrops in Belfield mod EPA PAGs
Plan ground-based measurements, EPA survey Pocatello, example
Change Detection, current application SRP, example

4) Advantages

Advantage: faster coverage, more than 4 sq mi/day
maps inaccessible areas, swamps or forests
high sensitivity, better than most PAGs
excellent reproducibility, 2%
reliable area averages, equal to 10s of ground-based
computer compatible data, mag tapes archived, SAS
cost effective, time in field 2 wks

5) Aerial Survey and Search Overview Figure

Consist of special helicopter flying series of uniformly
Spaced parallel lines at constant altitude and air speed.
Helo equipped with NaI(Tl) detector array, data recording and
Analysis system plus navigation system.
Data acquired include: dual gamma spectra, plus other rad data,
Position, altitude and environmental data.
Data acquired each second, recorded on tape for later analysis.

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Position determined by variety of means; xponders, INS, LORAN
Pilot guided by navigational display, from on-board computer.

6) Total Gamma Spectrum

Example from Sesquehanna NPP, total spectrum
2 spectra each sec, high & low sensitivity, broad dynamic range
Energy range covers almost all gamma emitters
Clearly identifies major contributors to exposure rate, natural

7) Net Gamma Spectrum

Background removed, reveals Co-58 & Co-60, was obscured
Locate, quantify and identify anomalous radiation

8) Products of Data Processing

Isopleth contours

Total exposure rate
Natural exposure rate
Man-made Gross count
Specific nuclides Cs-137, Co-60, I-131, 133
U-235, D-38, Bi-214, K, Tl-208, Am-241, etc.

Plot plumes of the above or noble gases

9) Sensitivity: 5% departure from background
30 - 50 nCi/m² for Cs or Co
better than most PAGs

freq. calibrations,
corrections airborne radon, alt, temp

10) Accuracy, difficult to quote, no single value
15% is typical exp. rt.
Q.A. major
test lines for absolute calibration

11) Precision, much better highly reproducible
2% typical for exposure rate
employ local test lines & cross-calibrations
pre-flight calibrations
corrections for air mass thickness & airborne radon

- 12) History
Nearly 300 surveys, most for environmental monitoring
Few for emergency mapping
Read viewfoil
- 13) Foreign Surveys
All accident responses
- 14) Surveys for Environmental Monitoring (NRC reactors)
Goals: Pre-op all, repeat each 5 years
Behind 5 on pre-op
Very far behind on repeat
- 15) Surveys for Environmental Monitoring (NRC waste sites)
Demonstrate environmental impact
Also, some other licensee sites
- 16) Surveys for Environmental Monitoring (EPA sites)
Most unrelated to uranium fuel cycle
Gas lantern mantel factories, Th-Al castings
Phosphate processing
- 17) Pocatello ID. Excess Uranium
EPA survey of radiological impact of Phosphorus tailings
Typical of most surveys
Used to plan and guide ground-based measurements
Quick assessment of scale and severity of problem
- 18) Pocatello Airport. (Zoomed View)
Easy to identify impacted roads and runways,
Focus soil sampling & air sampling (immediate repositioning)
Leading cost benefit: FOCUS Ground Measuring Program
- 19) Surveys for Environmental Monitoring (SRP)
Best example SRP, CIRS for many years
Program to map site and document changes

14 year period, 8 surveys, 5 repeat same area
Many radiation surveys were coupled with photo & IR surveys
Always provide 4 contour plots
Total exp. rt., natural exp. rt., Cs-137 & Co-60

20) SRP 85 Total Dose

Portion of Steel Creek at SRP 1985 prior to L reactor start
Concern was hot water resuspension

21) SRP 86 Total Dose

Resurveyed after L reactor start up
Question what are all the changes
Fast reports show revised maps and point out large changes
Look for small subtle changes, not just large

22) SRP 86/85 Comparison

Recent work compares surveys in great detail
Precise normalizations to produce point-by-point difference
Example: annual dose difference between 1985/1986
L reactor start up, look for hot water redistribution
Changes reflect differences in distribution (flooding)
and soil moisture
Differences here as small as 10%

23) Rancho Seco Nuclear Power Plant. (Exposure Rate 1980/84)

Same processing as before, difference too little to plot
Blue contours are different, black no change
Not striking, less than 10%

24) Rancho Seco Nuclear Power Plant. (Man-made 1980)

Using stripping technique NMGC
MMGC processing (sum of all man-made nuclides present)
1000 cps per microR (depends on nuclide mix)
Shine from plant and stored material on-site

25) Rancho Seco Nuclear Power Plant. (Man-made 1984)

4 years later, tremendous difference appears
Considerable downstream contamination

Irrigation has transported into vineyards
Differences clear, measurable
Estimated inventory

26) Applications

Conclude: Valuable means on environmental monitoring and planning environmental monitoring

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Advantage: faster coverage, more than 4 sq mi/day
maps inaccessible areas, swamps or forests
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excellent reproducibility, 2%
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computer compatible data, mag tapes archived, SAS
cost effective, time in field 2 wks

Disadvantages: special equipment,
compromised spatial resolution,
may require corroborate ground-based measurements

28) In-Situ Gamma Spectroscopy Overview Figure

Usually used for cleanups and corroborate measurements
Ideal for surface distributions
Best data at Gore, Ok.

29) B-200 Photo

Gas & airborne particulate sampling
Adding SF6 mapping capability

AERIAL RADIOLOGICAL SURVEYS ENVIRONMENTAL APPLICATIONS

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AERIAL RADIOLOGICAL SURVEY APPLICATIONS

- SEARCH FOR RADIATION ANOMALIES
- OVERVIEW OF LARGE AREAS
- PLAN GROUND-BASED MEASUREMENTS
- CONDUCT CHANGE DETECTION

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REDAR IV

STEERING INDICATOR

MBB BO-105 HELICOPTER

STEERING INDICATOR

DETECTOR POD

NaI DETECTOR

DATA VAN (PRELIMINARY ANALYSIS)

TRANSPONDER

UHF RANGING SYSTEM

FLIGHT LINES

SURVEY BOUNDARY

100' - 150'

2 MILES MINIMUM
100 MILES MAXIMUM
APART

BACKGROUNDS

NET SPECTRUM

DATA ANALYSIS PRODUCTS

ISOPLETH CONTOUR PLOTS OF:

- TOTAL EXPOSURE RATE
- NATURAL EXPOSURE RATE
- MAN-MADE GROSS COUNT
- SPECIFIC RADIONUCLIDE CONCENTRATIONS
(nCi/m²) or (pCi/gr)
- AIRBORNE PLUMES

SENSITIVITY

- 5% DEPARTURES FROM BACKGROUND
- 30 - 50 nCi/m² FOR ¹³⁷Cs OR ⁶⁰Co
- BETTER THAN MOST PAGES

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ACCURACY

- NO SINGLE VALUE
- 15% TYPICAL FOR EXPOSURE RATE
- MAINTAIN "TEST LINES" FOR ABSOLUTE CALIBRATION

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PRECISION

- HIGHLY REPRODUCIBLE
- 2% TYPICAL FOR EXPOSURE RATE
- LOCAL TEST LINES
- PREFLIGHT CALIBRATIONS
- CORRECTIONS FOR AIR MASS THICKNESS AND AIRBORNE RADON

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HISTORY

- APROX. 300 SURVEYS CONDUCTED
- 19 DOE FACILITIES
- 22 NTS, NMI, & JOHNSTON IS.
- 19 FUSRAP SITES
- 24 UMTRAP SITES
- 20 NAVAL REACTOR SITES
- ALL OF KSC

FOREIGN SURVEYS

- NORTHWEST TERRITORY, CANADA
- MATURIN, VENZ.
- CHIHUAHUA AND JUAREZ, MEX.
- MARALINGA, AUS.

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ALL COMMERCIAL
NUCLEAR POWER PLANTS

BEFORE START-UP
EACH 5 YEARS OF OPERATION

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NRC LICENSEE WASTE MANAGEMENT SITES

CHEM - NUCLEAR SYSTEMS, INC., BARNWELL, SC
U. S. ECOLOGY, MAXEY FLATS, KY
U. S. ECOLOGY, BEATTY, NV
U. S. ECOLOGY, SHEFFIELD, IL
U. S. ECOLOGY, RICHLAND, WA

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ENVIRONMENTAL PROTECTION AGENCY SURVEYS

POCATELLO & SODA SPRINGS, ID

PORT HENRY, NY

NEWARK, NJ

CAMDEN, NJ

ORANGE, NJ

GLOUCESTER, NJ

SAVANNAH RIVER PLANT

MONITOR CHANGES
RECURRENT SURVEYS

1974 1984

1979 1985

1982 1986

1983 1987

CONDUCT DETAILED COMPARISONS
NUCLEAR & NON-NUCLEAR

1985 SRP DOSE

PHOTO DATE: 7 APRIL 1984

1986 SRP DOSE

PHOTO DATE 7 APRIL 1984

1985/1986 SRP DOSE DIFFERENCE

ANNUAL DOSE CONVERSION SCALE	
LETTER LAYER	ANNUAL DOSE DIFFERENCE (microSv)
A	< 5
B	5 - 25
C	25 - 75
D	75 - 145
E	145 - 265
F	265 - 525

*These values represent the approximate
Annual Dose Difference of gamma rays with
energies 40 keV and 1300 keV.

PHOTO DATE: 7 APRIL 1984

RANCHO SECO 1984 EXPOSURE RATES

DATE OF MAP: 1988
PHOTO REVISED: 1975

RANCHO SECO 1980 MAN-MADE CONTAMINATION

RANCHO SECO 1984 MAN-MADE CONTAMINATION

AERIAL RADIOLOGICAL SURVEY ADVANTAGES

- FAST COVERAGE
- MAPS INACCESSIBLE AREAS
- HIGH SENSITIVITY
- EXCELLENT REPRODUCIBILITY
- RELIABLE AREA AVERAGES
- COMPUTER COMPATIBLE DATA
- COST EFFECTIVE

HIGH PURITY GERMANIUM IN SITU GAMMA SYSTEMS

B-200 SAMPLING AND TRACKING AIRCRAFT