

National Nuclear Laboratory



Some Recent Technology Developments
From The UK's National Nuclear Laboratory
To Enable Hazard Characterisation For
Nuclear Decommissioning Applications

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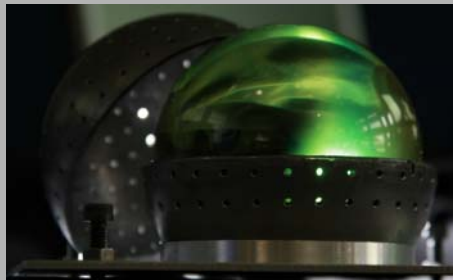
Presented by : Steven Stanley (Technology Manager)

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IR&D at the NNL

- £1M per year pledged
- Develop NNL owned IP through self investment
- Three projects described here started as IR&D
 - RadBall
 - HiRAD
 - Wireless Underwater Robots



Radiation Mapping with RadBall

RadBall is a deployable radiation mapping device which can **locate** and **quantify** radiation hazards from a single position.

What can RadBall™ be used for?

The RadBall™ can be used to offer a radiation mapping service:

- Radiation mapping in:
 - Active cells
 - Glovebox
 - Confined spaces
 - Hard to reach parts of the plant
 - Plants with high radiation levels (up to Sv/hr)
- Quality control for decontamination efforts
 - Before and after surveys
 - Detection of untreated areas



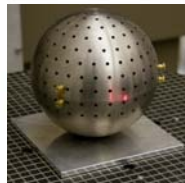
What is RadBall™ made of?

RadBall consists of a colander-like outer collimator that houses a radiation-sensitive PRESAGE™ polymer sphere.



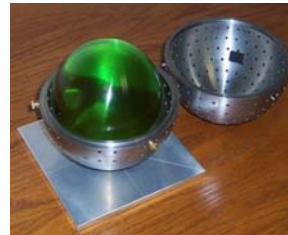
Polymer plastic

+



Collimation sheath

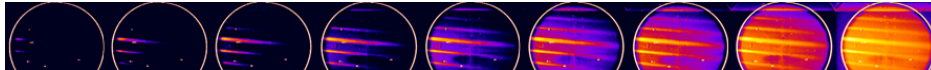
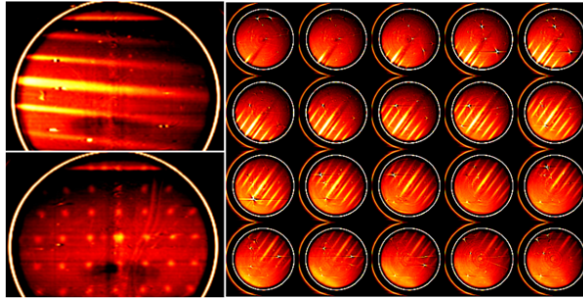
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How does the RadBall™ work?

- PRESAGE™ changes colour when exposed to radiation.
- Amount of colour change is dose dependant.
- Radiation produces discrete tracks
- Allows location and quantity of radiation to be determined



Why is the RadBall™ so useful?

- Deployable
- Maps the 3D radiation distribution
- Does not require any power
- Does not require any communication link
- Can eliminate radiation exposure to personnel
- Minimal liability

How is RadBall™ deployed?

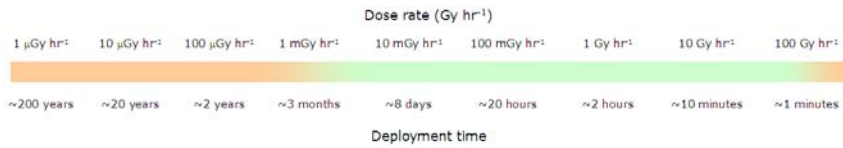
- Hung from a crane
- Positioned using a manipulator
- Robotic Deployment system*
- Automated RadBall™ locater*



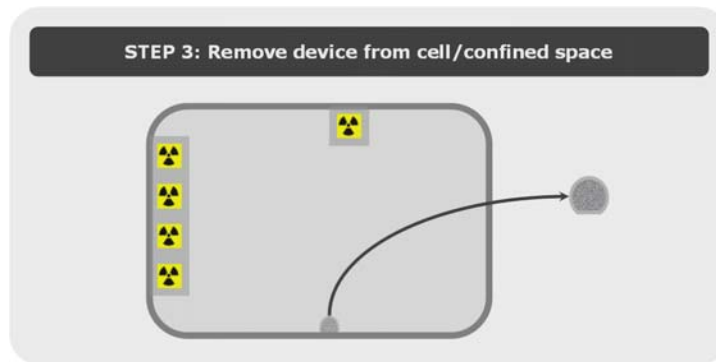
How does the “service” work?



How does the "service" work?



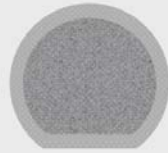
How does the "service" work?



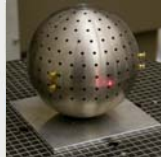


How does the "service" work?

STEP 4: Remove collimation sheath



Proposed device



Collimation sheath

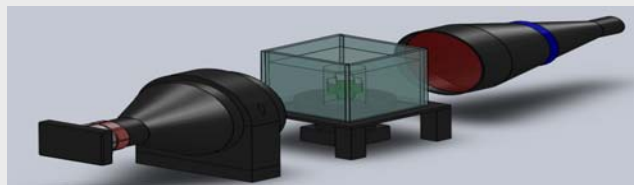


Polymer plastic



How does the "service" work?

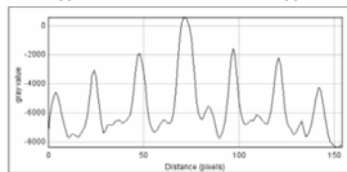
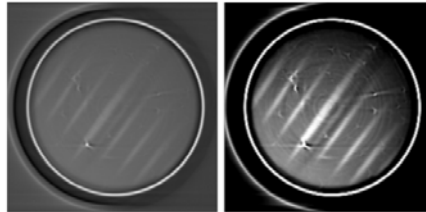
STEP 5: Analyse polymer plastic matrix



Polymer plastic sample is rotated to obtain 3D information



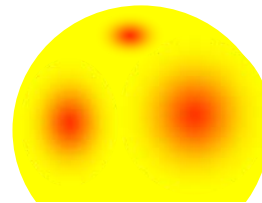
How does the "service" work?



How does the "service" work?

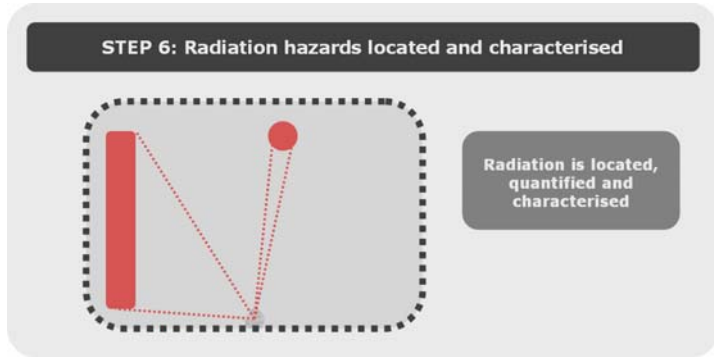
BASIC OUTPUT:

Radiation deposited on the device
From a particular direction
+
An estimate of the incident
radiation energy

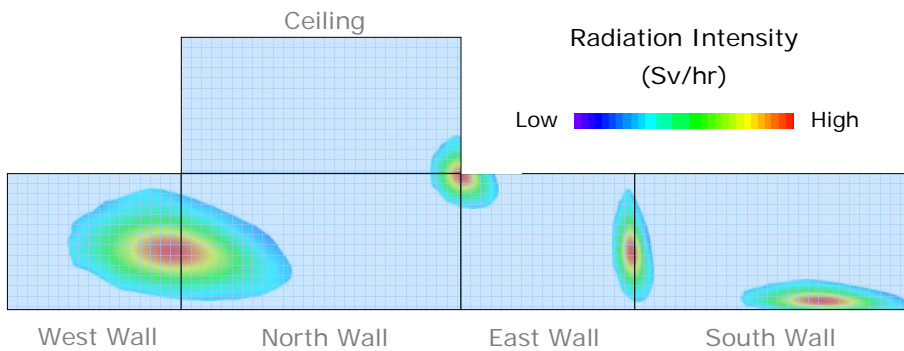


Radiation Intensity (Sv/hr)
Low High

How does the "service" work?



What is the output?





Sounds good but does it work?



Off to the USA (Savannah River National Lab)

Table 1: RADBALL Calibration Results - Experiment 1

Run	Time (min)	Radball Status (m)	Radball	Calibrated Radball (mSv)
1	10	OK	0121	0.01
2	10	OK	0121	0.01
3	10	OK	0121	0.01
4	10	OK	0121	0.01
5	10	OK	0121	0.01
6	10	OK	0121	0.01
7	10	OK	0121	0.01
8	10	OK	0121	0.01
9	10	OK	0121	0.01
10	10	OK	0121	0.01
11	10	OK	0121	0.01
12	10	OK	0121	0.01
13	10	OK	0121	0.01
14	10	OK	0121	0.01
15	10	OK	0121	0.01
16	10	OK	0121	0.01
17	10	OK	0121	0.01
18	10	OK	0121	0.01
19	10	OK	0121	0.01
20	10	OK	0121	0.01
21	10	OK	0121	0.01
22	10	OK	0121	0.01
23	10	OK	0121	0.01
24	10	OK	0121	0.01
25	10	OK	0121	0.01
26	10	OK	0121	0.01
27	10	OK	0121	0.01
28	10	OK	0121	0.01
29	10	OK	0121	0.01
30	10	OK	0121	0.01
31	10	OK	0121	0.01
32	10	OK	0121	0.01
33	10	OK	0121	0.01
34	10	OK	0121	0.01
35	10	OK	0121	0.01
36	10	OK	0121	0.01
37	10	OK	0121	0.01
38	10	OK	0121	0.01
39	10	OK	0121	0.01
40	10	OK	0121	0.01
41	10	OK	0121	0.01
42	10	OK	0121	0.01
43	10	OK	0121	0.01
44	10	OK	0121	0.01
45	10	OK	0121	0.01
46	10	OK	0121	0.01
47	10	OK	0121	0.01
48	10	OK	0121	0.01
49	10	OK	0121	0.01
50	10	OK	0121	0.01

Table 2: RADBALL Calibration Results - Experiment 2

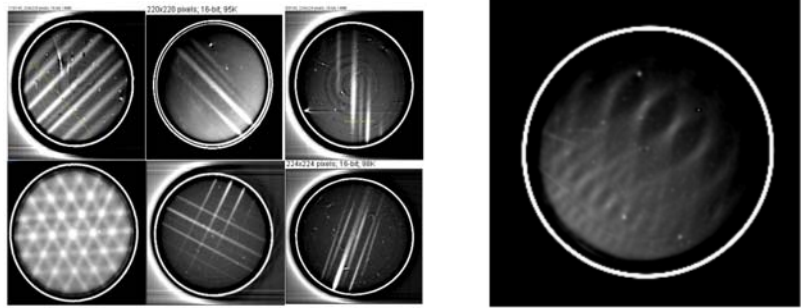
Run	Time (min)	Radball Status (m)	Radball	Calibrated Radball (mSv)
1	10	OK	0121	0.01
2	10	OK	0121	0.01
3	10	OK	0121	0.01
4	10	OK	0121	0.01
5	10	OK	0121	0.01
6	10	OK	0121	0.01
7	10	OK	0121	0.01
8	10	OK	0121	0.01
9	10	OK	0121	0.01
10	10	OK	0121	0.01
11	10	OK	0121	0.01
12	10	OK	0121	0.01
13	10	OK	0121	0.01
14	10	OK	0121	0.01
15	10	OK	0121	0.01
16	10	OK	0121	0.01
17	10	OK	0121	0.01
18	10	OK	0121	0.01
19	10	OK	0121	0.01
20	10	OK	0121	0.01
21	10	OK	0121	0.01
22	10	OK	0121	0.01
23	10	OK	0121	0.01
24	10	OK	0121	0.01
25	10	OK	0121	0.01
26	10	OK	0121	0.01
27	10	OK	0121	0.01
28	10	OK	0121	0.01
29	10	OK	0121	0.01
30	10	OK	0121	0.01
31	10	OK	0121	0.01
32	10	OK	0121	0.01
33	10	OK	0121	0.01
34	10	OK	0121	0.01
35	10	OK	0121	0.01
36	10	OK	0121	0.01
37	10	OK	0121	0.01
38	10	OK	0121	0.01
39	10	OK	0121	0.01
40	10	OK	0121	0.01
41	10	OK	0121	0.01
42	10	OK	0121	0.01
43	10	OK	0121	0.01
44	10	OK	0121	0.01
45	10	OK	0121	0.01
46	10	OK	0121	0.01
47	10	OK	0121	0.01
48	10	OK	0121	0.01
49	10	OK	0121	0.01
50	10	OK	0121	0.01

Table 3: RADBALL Calibration Results - Experiment 3

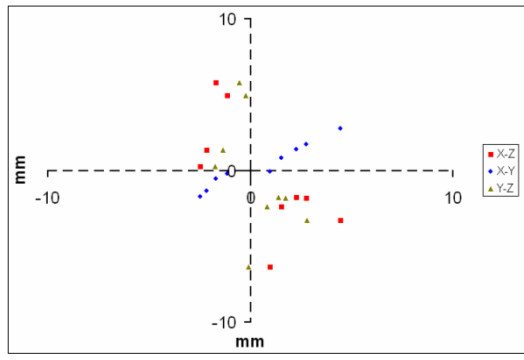
Run	Time (min)	Radball Status (m)	Radball	Calibrated Radball (mSv)
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2	10	OK	0121	0.01
3	10	OK	0121	0.01
4	10	OK	0121	0.01
5	10	OK	0121	0.01
6	10	OK	0121	0.01
7	10	OK	0121	0.01
8	10	OK	0121	0.01
9	10	OK	0121	0.01
10	10	OK	0121	0.01
11	10	OK	0121	0.01
12	10	OK	0121	0.01
13	10	OK	0121	0.01
14	10	OK	0121	0.01
15	10	OK	0121	0.01
16	10	OK	0121	0.01
17	10	OK	0121	0.01
18	10	OK	0121	0.01
19	10	OK	0121	0.01
20	10	OK	0121	0.01
21	10	OK	0121	0.01
22	10	OK	0121	0.01
23	10	OK	0121	0.01
24	10	OK	0121	0.01
25	10	OK	0121	0.01
26	10	OK	0121	0.01
27	10	OK	0121	0.01
28	10	OK	0121	0.01
29	10	OK	0121	0.01
30	10	OK	0121	0.01
31	10	OK	0121	0.01
32	10	OK	0121	0.01
33	10	OK	0121	0.01
34	10	OK	0121	0.01
35	10	OK	0121	0.01
36	10	OK	0121	0.01
37	10	OK	0121	0.01
38	10	OK	0121	0.01
39	10	OK	0121	0.01
40	10	OK	0121	0.01
41	10	OK	0121	0.01
42	10	OK	0121	0.01
43	10	OK	0121	0.01
44	10	OK	0121	0.01
45	10	OK	0121	0.01
46	10	OK	0121	0.01
47	10	OK	0121	0.01
48	10	OK	0121	0.01
49	10	OK	0121	0.01
50	10	OK	0121	0.01



About 50 irradiations in the Lab



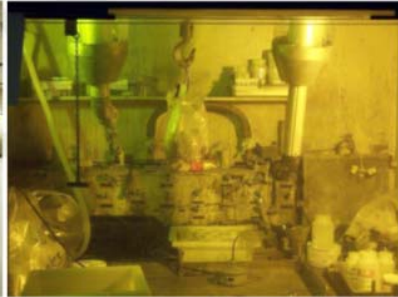
Locating radiation at 1m (in the lab)





RADBALL: THE DEPLOYABLE RADIATION MAPPING DEVICE

....onto a real HOTCELL

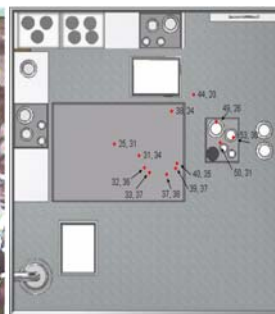


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RADBALL: THE DEPLOYABLE RADIATION MAPPING DEVICE

1st Real Success



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RADBALL: THE DEPLOYABLE RADIATION MAPPING DEVICE

What next?

- More DOE funded trials
- Software developments
- Scanner purchase

- ...launch the technology in UK then...

- In Europe and USA "WE NEED PARTNERS!"

- Are you interested in partnering or licensing this technology?

HiRAD Radiation Detection System

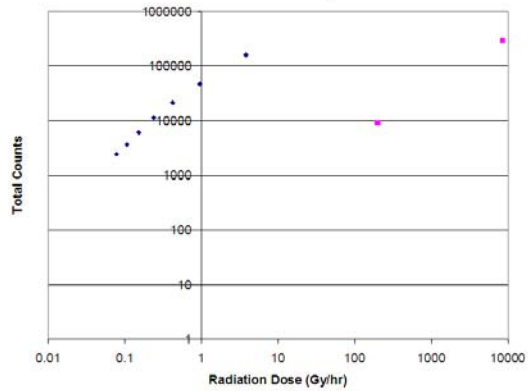


HiRAD is a deployable non-electrical fibre optic based radiation detector that can be positioned and moved around in order to take spot measurements

HiRAD Radiation Detection System

What can HiRAD be used for?

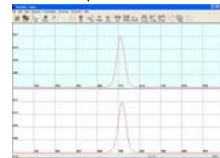
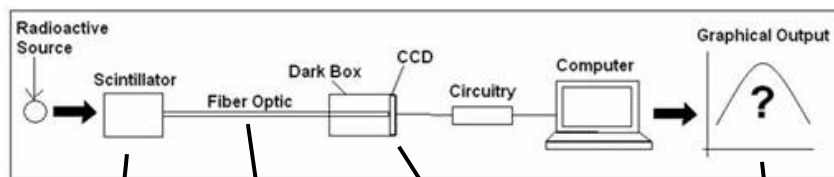
- Detecting radiation
- Very deployable
- Massive dynamic range
- Tested up to 8,500 Gy hr⁻¹
- Performs at lower levels (mGy hr⁻¹)



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HiRAD Radiation Detection System


What is HiRAD made of and how does it work?



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HiRAD Radiation Detection System


Sounds good but
does it work?

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HiRAD Radiation Detection System

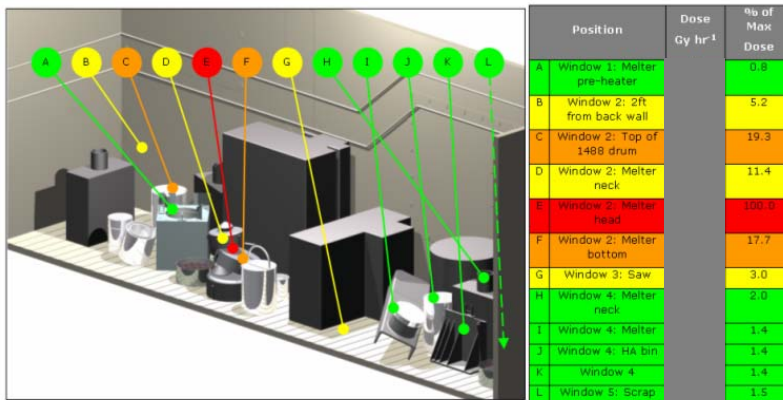
Sellafield Waste Vitrification Plant Trial



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HiRAD Radiation Detection System

Sellafield Waste Vitrification Plant Trial



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HiRAD Radiation Detection System

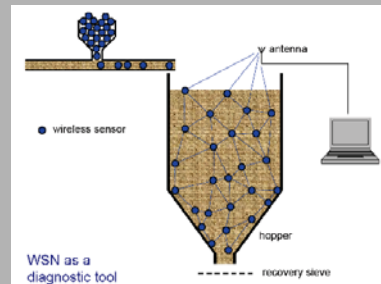
What next?

- Characterisation of radiation sources
- Real time read out.
- ...launch the technology in UK then...
- In Europe and USA "WE NEED PARTNERS!"
- Are you interested in partnering or licensing this technology?

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...and finally...

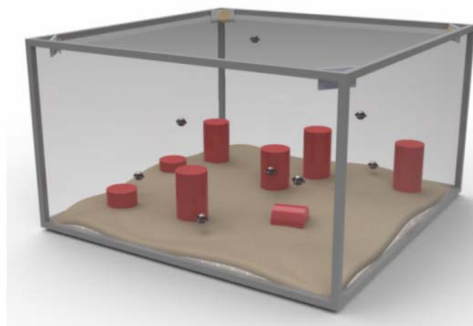
Underwater Wireless Robots for Pond Mapping



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Underwater Robots

- Robot development
- Wireless comms
- Wireless positioning
- Exploration strategy
- (pay load) sensor development
- Powering issues



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THANKS FOR LISTENING