

# **Ceretom Mobile CT Scanner in Neuro-Intensive Care; Aspects in Regulatory Compliance and Radiation Protection**

G. Stevens<sup>1</sup>, N. Rowles<sup>1</sup>, R. Foy<sup>2</sup>, R. Loader<sup>1</sup>, N. Barua<sup>3</sup>, and J. Palmer<sup>3</sup>

1. Clinical & Radiation Physics, Plymouth Hospitals NHS Trust
2. Medical Physics, Royal Cornwall NHS Trust
3. Neurosciences, Plymouth Hospitals NHS Trust



# Issues in Neurological Care of the Patient

1. The time to complete an image can be critical to successful outcome for the patient.
2. Moving fragile patients with head trauma can lead to adverse incidents for patient.
3. Two week audit into neurological patients requiring urgent scans.
  - 85% infusions/ventilated
  - 95% arterial lines
  - 16% patients problematic
  - Median time of scan 55min (range: 35-110min)

# Medical Physics Issues

Ceretom designed for US market: 50mSv versus 20mSv dose limit.

Compliance with IRR99

- (8) - restriction of exposure
- (16) - CA designation
- (18) - control of entry to CA
- (31) - manufacturers duties

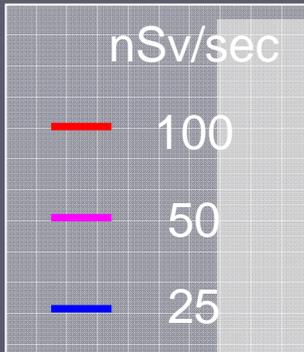
Compliance with ACOP 79

Compliance with H&S(1974) (trap hazard, audible warnings *etc.*)

# Radiation Protection Methodology

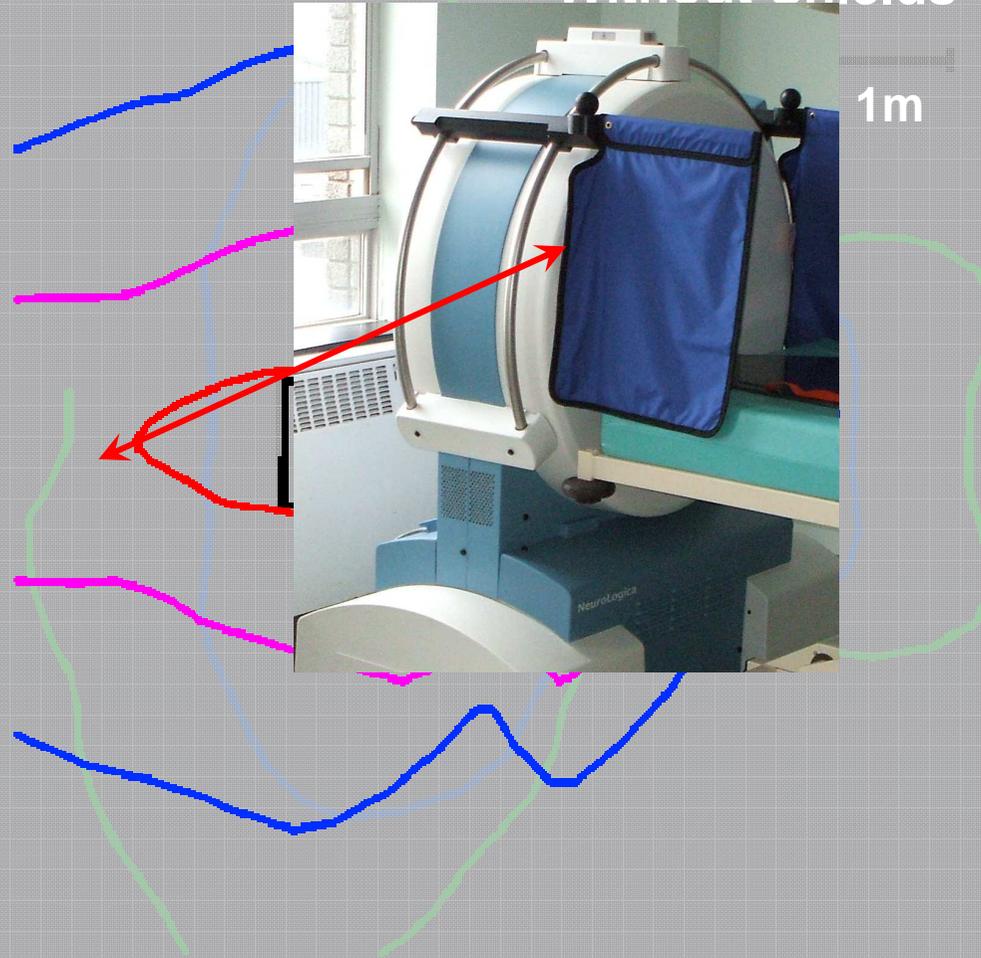
- Increased internal shielding
- Development of “shadow shields”
- More realistic patient based scatter map
- CA/SA calculation based on above map
- Simulation of work on the ward
- Monitoring

# Engineering Controls Results...



With Shields

Without Shields



# Scatter Map Measurements to define the CA/SA



Ceretom

BED



# Controlled and Supervised Area Designation

## Without Chest Phantom

	4	3	2	1	0	-1	-2	-3	-4
-4	NDA	NDA	SA	SA	SA	SA	SA	NDA	NDA
-3	NDA	NDA	SA	SA	SA	SA	SA	NDA	NDA
-2	NDA	SA	SA	SA	CA	SA	SA	SA	NDA
-1	SA	SA	CA	CA	CA	CA	CA	SA	SA
0	SA	CA	CA	CA	CA	CA	CA	CA	SA
1	SA	SA	CA	CA	CA	CA	CA	SA	SA
2	SA	CA	CA	CA	CA	CA	CA	CA	SA
3	SA	CA	CA	CA	CA	CA	CA	CA	SA
4	SA	SA	CA	CA	CA	CA	CA	SA	SA
5	SA	SA	CA	CA	CA	CA	CA	SA	SA
6	SA	SA	CA	CA	CA	CA	CA	SA	SA
7	SA	SA	CA	CA	CA	CA	CA	SA	SA
8	SA	SA	SA	CA	CA	CA	SA	SA	SA

## With Chest Phantom

	4	3	2	1	0	-1	-2	-3	-4
-4	SA								
-3	SA								
-2	SA	SA	CA	CA	CA	CA	CA	SA	SA
-1	CA								
0	SA	CA	SA						
1	SA	CA	SA						
2	CA								
3	CA								
4	SA	CA	SA						
5	SA	SA	SA	CA	SA	CA	SA	SA	SA
6	SA								

Each Square = 1m X 1m

# Total Cumulative Annual Dose ( $\mu\text{Sv}$ ) based on 105 Scans per bed per year

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	81	10	57	103	104	92	83	84	100	127	166	206	153	106	161
2	121	61	85	151	152	133	119	132	149	172	235	345	387	208	222
3	161	106	153	226	192	158	141	145	167	220	308	495	1165	700	389
4	222	208	387	345	238	178	160	151	173	212	292	BED1			276
5	308	730	1165	514	331	249	206	196	222	283	389	617	1281	826	389
6	276		BED2		315	242	212	221	246	281	386	614	694	411	384
7	389	826	1281	632	412	308	254	242	269	337	464	677	1296	834	438
8	384	411	694	622	406	294	262	238	262	314	418	BED3			373
9	438	834	1296	695	463	348	283	265	289	356	475	697	1304	836	462
10	373		BED4		416	321	271	280	296	329	444	660	713	415	424
11	462	836	1304	697	476	357	290	270	292	359	477	699	1304	836	461
12	424	415	713	650	433	314	277	249	270	320	415	BED5			380
13	461	836	1304	696	474	355	287	265	285	349	465	696	1296	834	454
14	380		BED6		411	315	264	270	282	308	417	632	694	411	399
15	454	834	1296	678	453	335	267	242	256	309	414	633	1281	826	389
16	399	411	694	609	390	274	236	203	211	241	315	BED7			283
17	399	826	1261	617	394	284	223	200	208	251	332	515	1165	700	325
18	283		BED8		292	213	174	169	170	185	244	350	387	208	236
19	325	730	1165	499	306	217	164	139	140	158	191	226	153	106	171
20	236	208	387	340	229	165	139	118	118	132	152	150	85	61	129

Each block is 1m x 1m

# Total Annual Patient Dose ( $\mu\text{Sv}$ ) based on a maximum 60 day stay

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	30	5	21	40	41	37	35	37	45	58	78	97	73	51	77
2	46	28	32	60	61	55	50	59	68	80	110	163	175	99	106
3	62	50	62	92	76	64	59	63	76	102	144	234	555	348	147
4	85	97	161	144	93	69	66	65	77	97	136	BED1			131
5	118	343	535	215	129	96	82	82	98	129	183	290	601	334	185
6	85		BED2		105	81	77	82	100	121	178	284	331	196	183
7	124	344	539	224	138	106	92	93	112	148	207	315	618	398	209
8	106	99	175	171	121	94	89	89	107	136	185	BED3			178
9	100	55	89	140	125	106	96	100	118	155	215	323	622	398	220
10	104		BED4		131	115	103	116	131	151	208	312	340	198	202
11	112	55	93	146	130	110	99	102	120	156	218	324	622	398	220
12	125	101	184	184	134	104	96	94	111	139	187	BED5			181
13	158	348	560	254	168	128	108	104	120	154	212	319	618	398	216
14	135		BED6		150	116	101	105	117	134	189	293	331	196	190
15	182	393	587	292	187	137	111	105	114	141	192	298	601	394	190
16	164	194	316	269	166	115	102	89	95	111	147	BED7			135
17	170	330	530	279	173	124	98	90	95	116	156	243	555	348	155
18	120		BED8		128	93	77	76	78	86	114	165	175	99	113
19	143	348	549	226	137	97	73	63	64	73	90	106	73	51	82
20	104	99	170	155	102	73	63	53	54	62	71	71	41	29	61

# Annual Staff Dose ( $\mu\text{Sv}$ ) based on a 40 week working year

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	41	5	29	51	52	46	41	42	50	63	83	103	76	53	81
2	61	30	43	75	76	66	59	66	75	86	118	172	184	104	111
3	81	53	76	113	96	79	71	72	84	110	154	247	583	365	154
4	111	104	184	173	119	89	80	76	87	106	146	BED1			138
5	154	365	583	257	166	124	103	98	111	142	197	308	630	413	194
6	138			BED2	158	121	106	111	123	140	198	307	347	205	192
7	194	413	630	316	206	154	127	121	134	168	227	338	648	417	219
8	192	205	347	311	203	147	131	119	131	157	205	BED3			186
9	219	417	648	342	232	174	142	132	144	178	237	348	652	418	231
10	186			BED4	208	161	136	140	148	165	222	330	357	208	212
11	231	418	652	348	238	179	145	135	146	179	238	348	652	418	230
12	212	208	357	325	216	157	138	124	135	160	207	BED5			190
13	230	418	652	348	237	177	143	132	143	175	232	343	648	417	227
14	190			BED6	205	158	132	135	141	154	209	316	347	205	200
15	227	417	648	338	227	167	133	121	128	155	207	317	630	413	199
16	200	205	347	308	195	137	118	101	105	121	157	BED7			141
17	199	413	630	308	197	142	111	100	104	125	166	257	583	365	162
18	141			BED8	146	106	87	84	85	93	122	175	184	104	118
19	162	365	583	247	153	109	82	70	70	79	95	113	76	53	86
20	118	104	184	170	115	82	70	59	59	66	76	75	43	30	64

# Main conclusions from discussions with HSE

- HSE: Ceretom can only be used when Trust can medically justify why imaging in a dedicated CT facility is impracticable.
- HSE: the Ceretom service must be 24/7 to justify use.
- HSE: Equipment calibration must be done with shadow shields closed.
- HSE: Audible buzzer in addition to flashing warning lights required.
- Local rules:
  - Extension of Radiographer responsibilities: responsibility of the control of access to CA .
  - Radiographer will wear a 0.35mmPb coat in case of emergency and complete scan behind lead screen.
  - Staff may in exceptional circumstances attend an adjacent patient from the side of the bed furthest from the Ceretom.

## Literature

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