Passive Dosimetry: Area and Crew Monitoring

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Main Passive Dosimetry Hardware

HARDWARE	WEIGHT (kg)	VOLUME (cm^3)	DIMENSIONS (cm)
Crew Passive Dosimeter (CPD)	0.021	31.6	11.5 x 5.5 x 0.5
Passive Radiation Dosimeters (PRD)	0.0085	8.25	5.5 x 3.0 x 0.5
Area Passive Dosimeter (APD)	0.137	530	10 x 10 x 5.3

- All dosimeter holders are made of Lexan, TLDs at 0.18 g/cm^2 depth
- 32 TLD chip capacity for CPD and PRD

Crew Passive Dosimeter

Passive Radiation Dosimeter

APD - Contained within RDA (shown below)

The RDA consists of a single pouch into which are incorporated an array of pocket ionization chambers (PIC) and the Area Passive Dosimeter (APD). The pouch is stored in a mid-deck locker during missions.

New Dosimeter Design

- This replaces CPD (Crew Passive Dosimeter) and PRD (Passive Radiation Dosimeter)
  Note: *Passive Radiation Dosimeter will now be called Radiation Area Monitor (RAM)*
- All dosimeter holders are made of Lexan - TLDs at 0.18 g/cm^2 depth
- New CPD and RAM will have **24** TLD chip capacity

Instruments/Equipment

- Harshaw 5500 Automatic TLD Readers (2)
  - hot N2 Gas Heating
- Harshaw 3500 Manual TLD Reader (1)
  - Planchet Heating
- Cs-137 Calibration Range
  - (JL Shepard, 600 mCi), Ion chambers, Electrometers
- Annealing Ovens (2)
- Vacuum Tweezers (4)

TLD Material

- TLD-100 - LiF:Mg,Ti (7.5% ^{6}Li and 92.5% ^{7}Li)
- TLD-600 - LiF :Mg,Ti (95.6% ^{6}Li and 4.4% ^{7}Li)
- TLD-700 - LiF :Mg,Ti (99.93% ^{7}Li and 0.07% ^{7}Li)
- TLD-300 - CaF_2:Tm

Chip size used = 3.2 mm x 3.2 mm x 0.9 mm

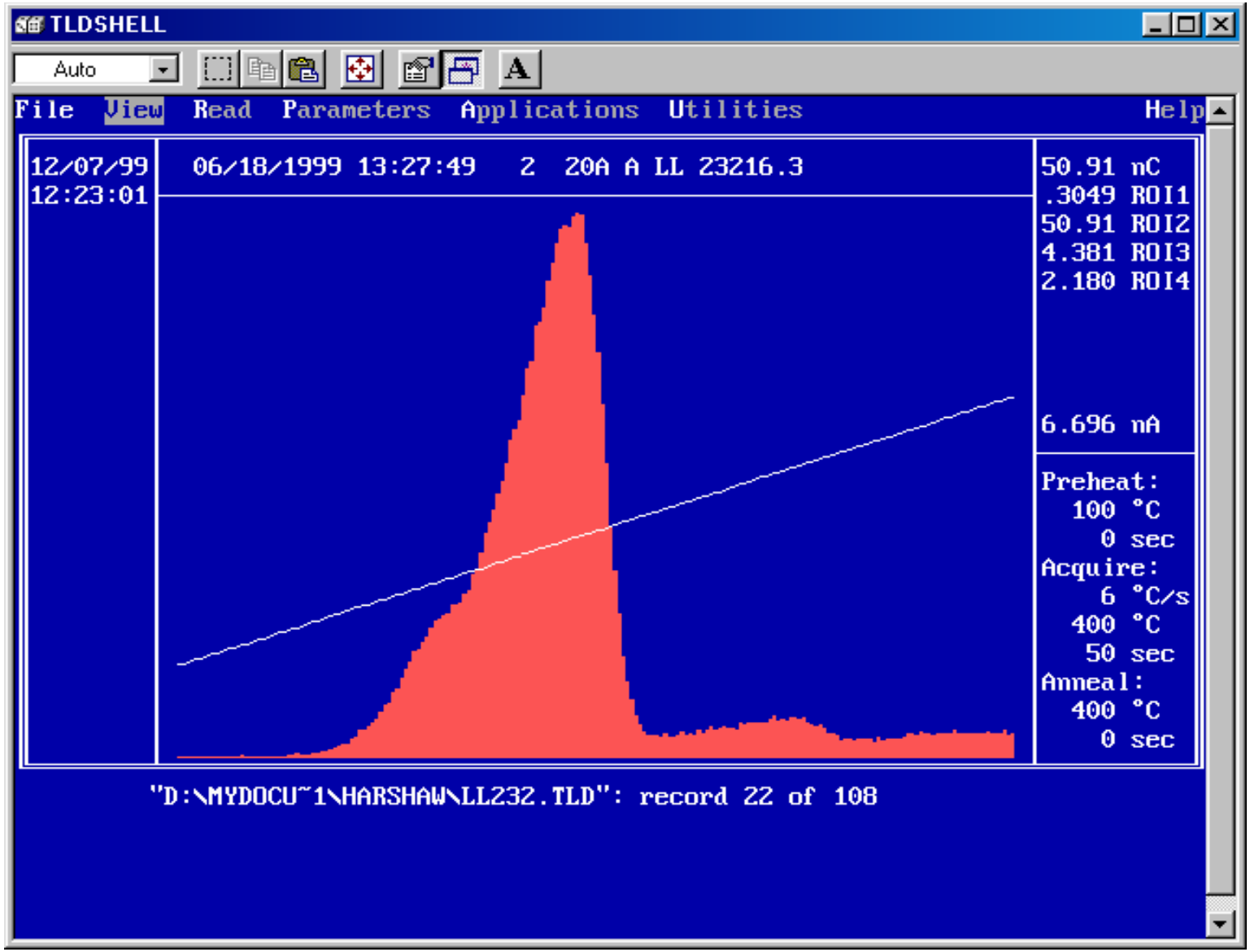
TLD-Methods

Method/Technique	**Material**	
	TLD-100,600,700	TLD-300
Annealing	400 °C for 1 hr followed by slow cool to room temp	400 °C for 1 hr followed by 100 °C for 2 hr
Pre-readout annealing	100 °C for 30 min	100 °C for 30 min
Reader	Harshaw 5500	Harshaw 5500
Temperature Range	100 – 400 °C	100 – 400 °C
Heating Rate	6 °C s^{-1}	6 °C s^{-1}
TL Evaluation Method	Region of Interest (ROI)	Region of Interest (ROI)

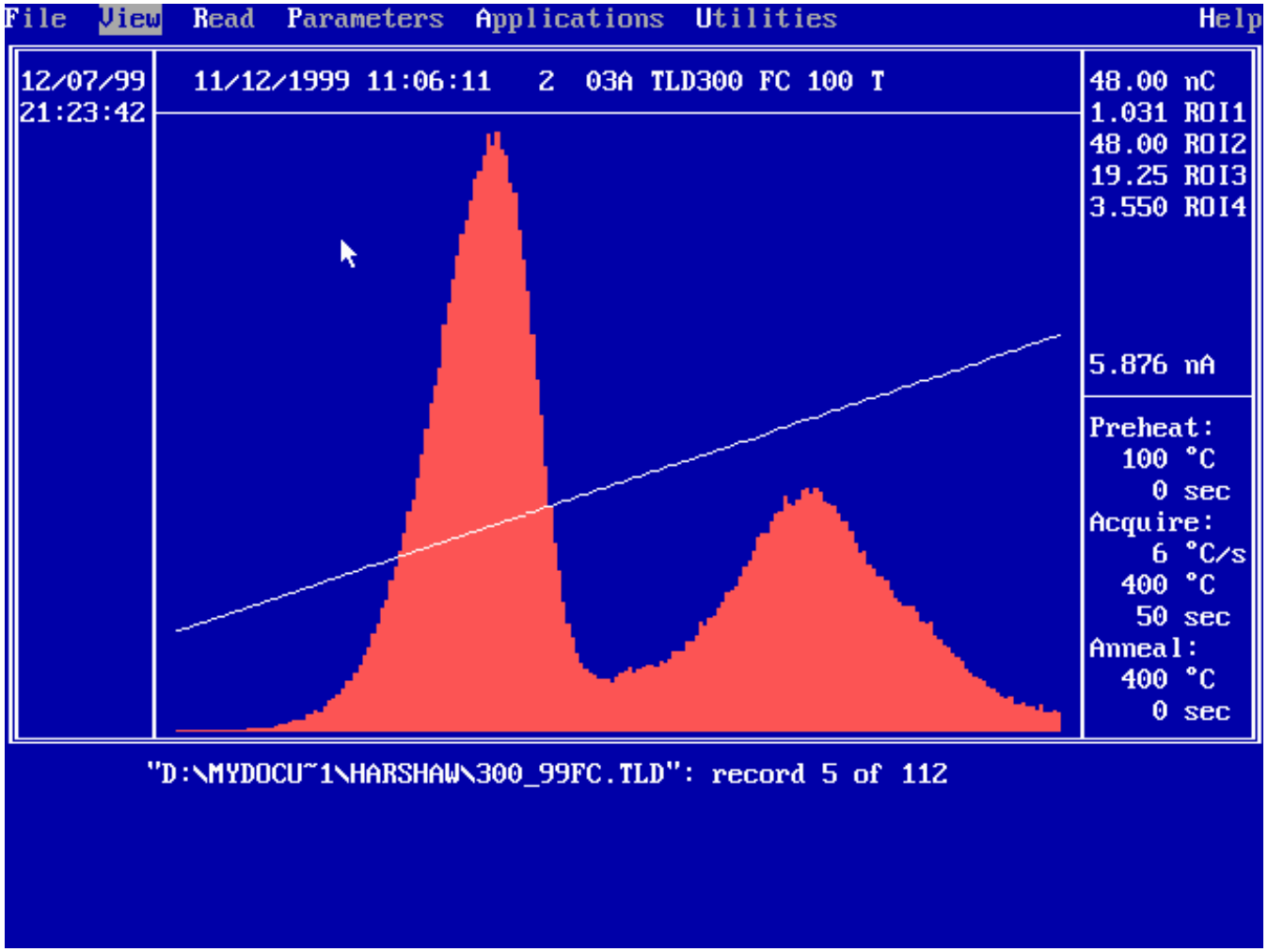
Calibration

- Irradiation with Cs-137
  - (662 keV photons) - Air Kerma = 2 mGy/h
- Performed according to ANSI N13.11-1993
  - With the exception of phantom - we irradiate dosimeters free-in-air
- Calibration in terms of free-space absorbed dose to tissue results in a calibration factor used to convert glow curve ROIs.

TLD-100 Glow Curve



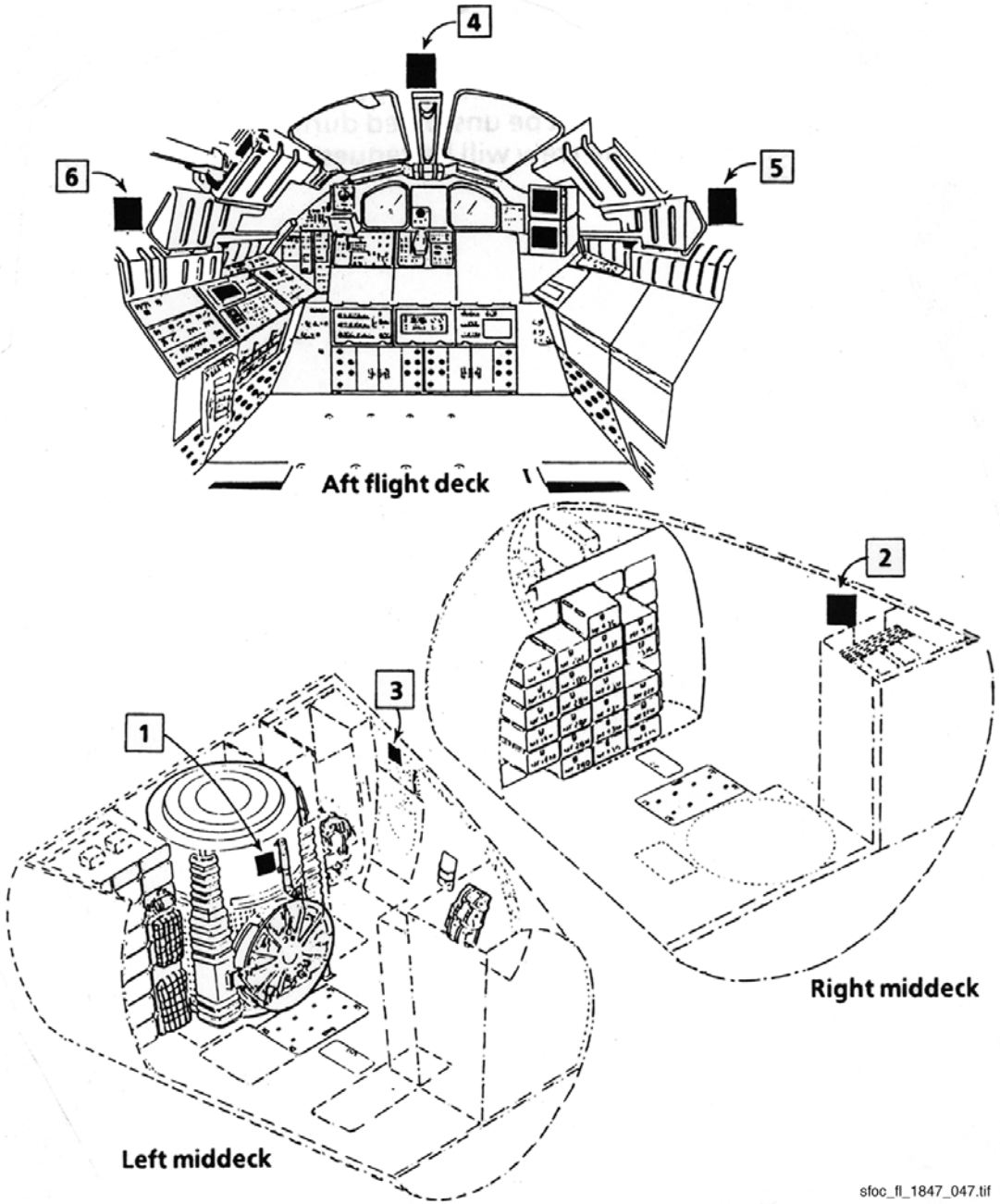
TLD-300 Glow Curve



Timeline

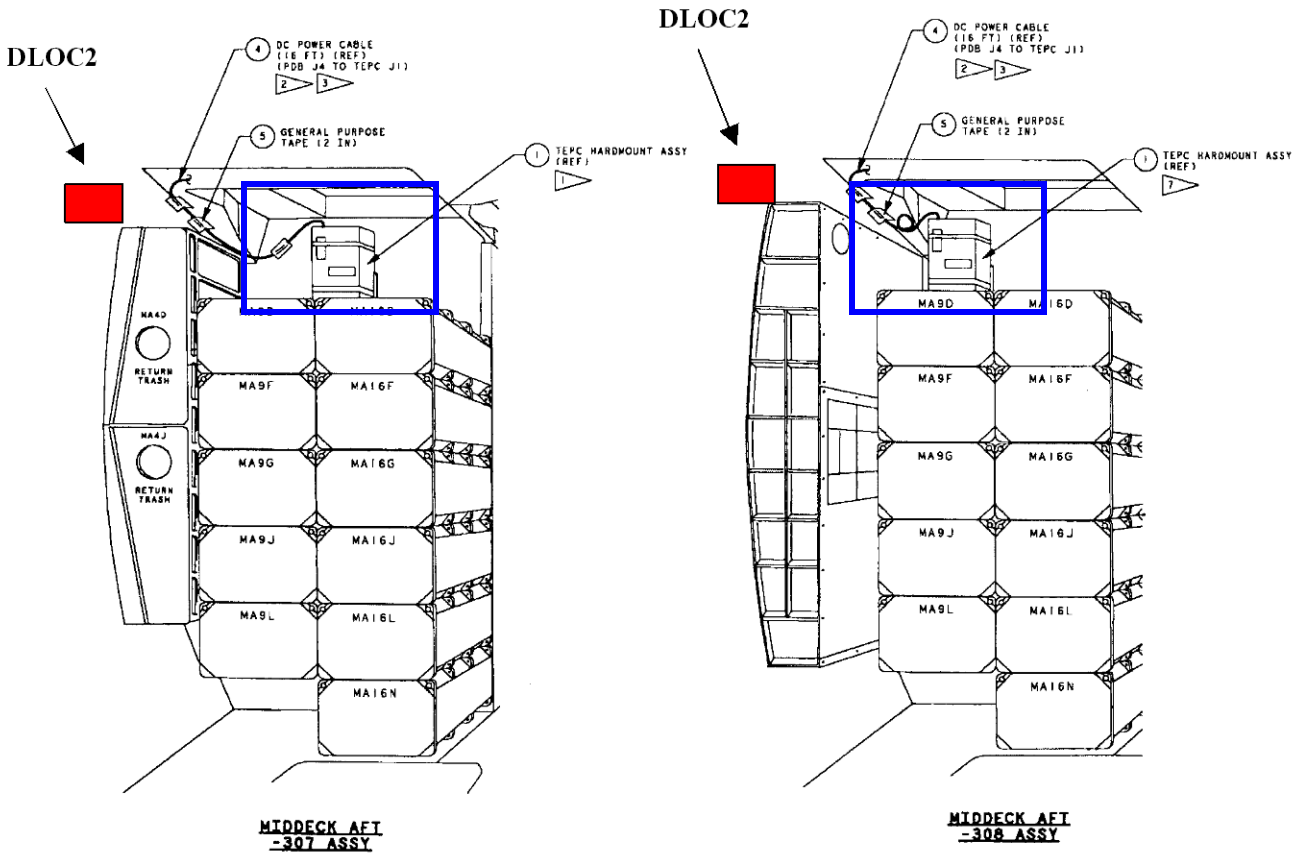
Prepare Work Start	
L-30D	**Select/Anneal TLD Material**
L-14D	**Dosimetry Delivered to USA/FCE**
	Irradiation of Calibration Dosimeters
	L A U N C H
	L A N D I N G
R+5D	**Dosimetry Received at USA/FCE**
R+7D	**Dosimetry Received at SRDLab**
R+7D - R+20D	**Dosimetry Readout - Flight, Controls, Calibration**
Dosimetry Report Generated - No Later Than R+30D	

PRD Locations in the Shuttle (DLOCs)

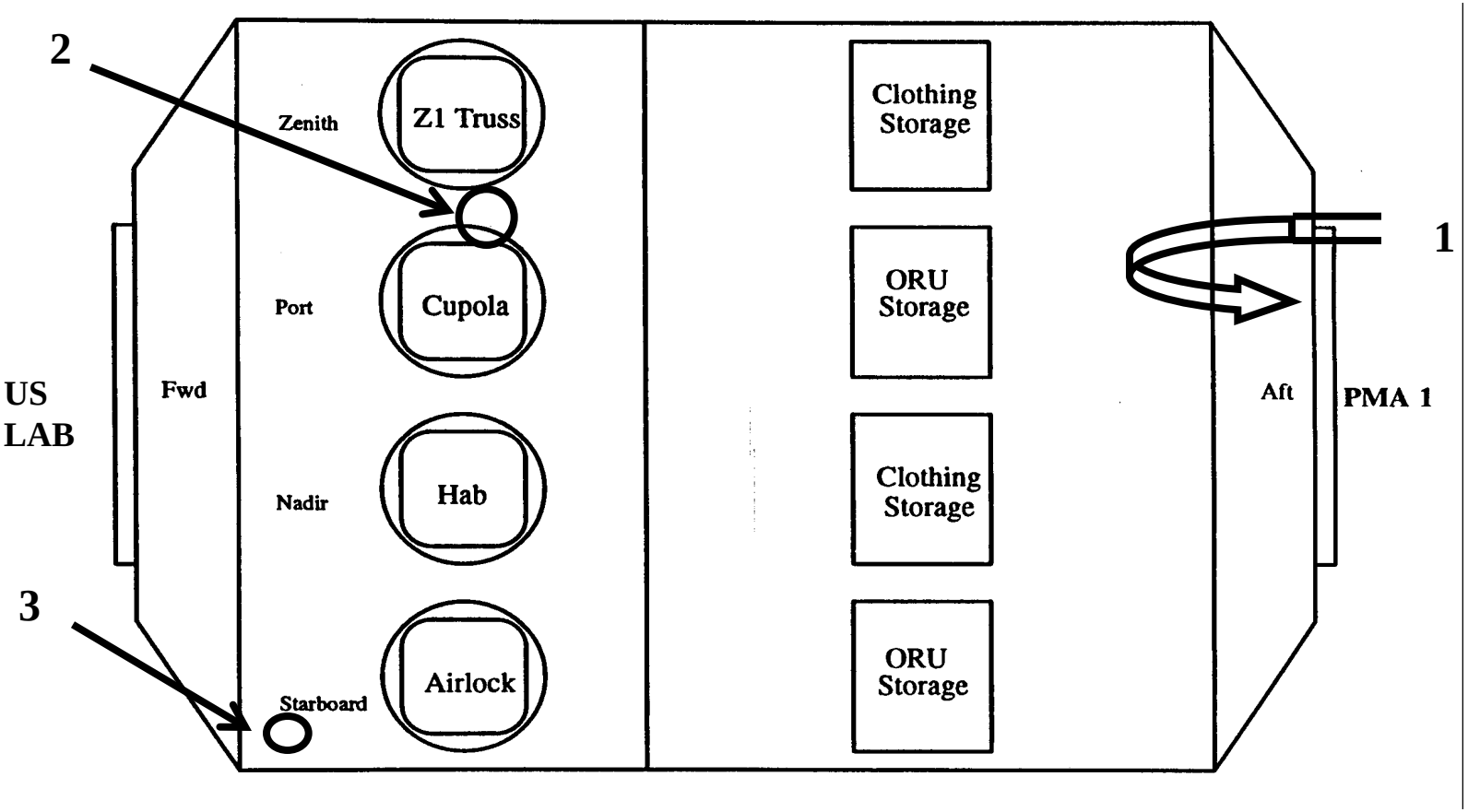


Location of Hardmounted Shuttle TEPC

with location of DLOC2 for Reference



NODE 1



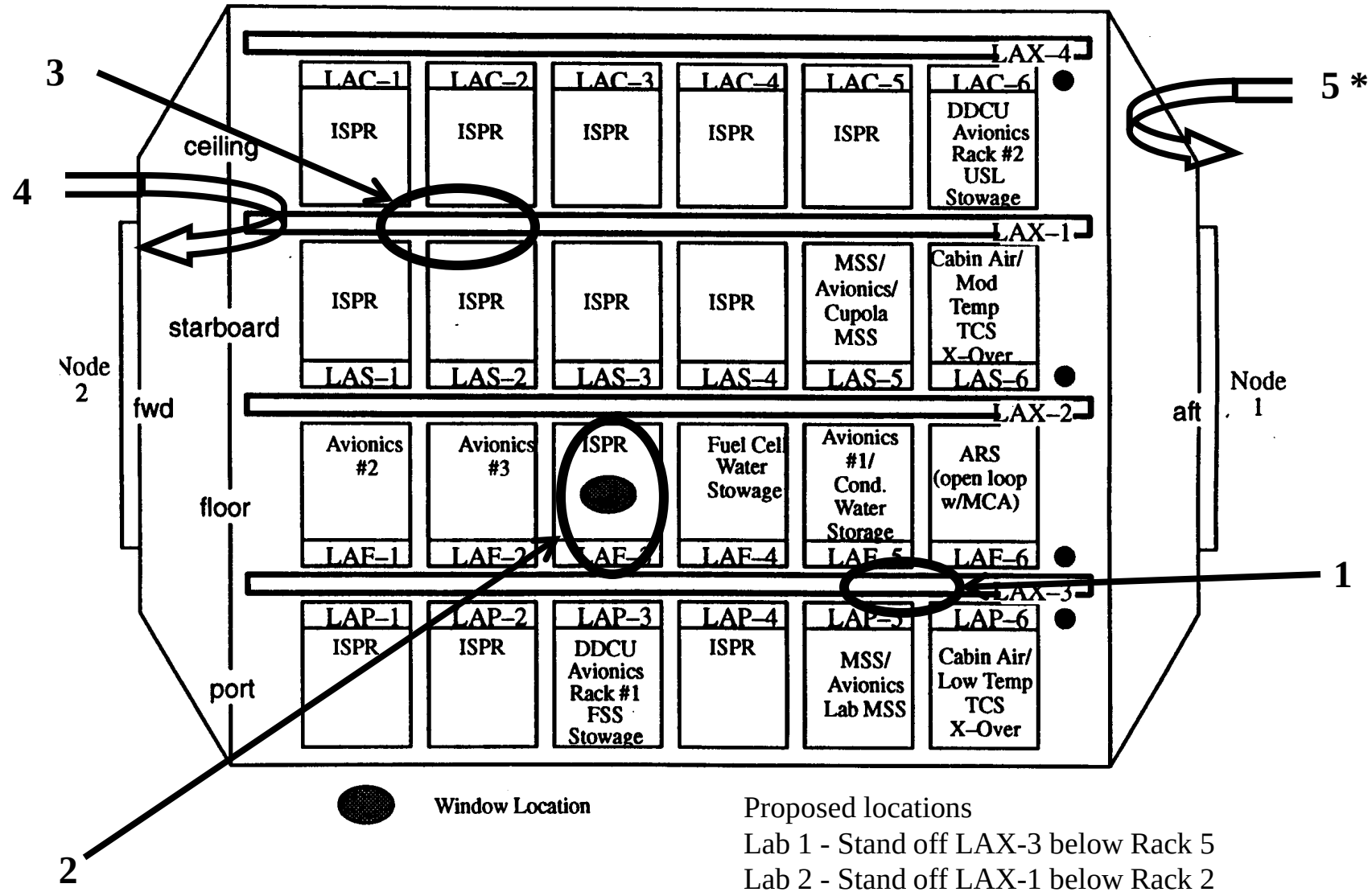
Node 1- 1 - Aft end, near hatch close out panel
Node 1- 2 - Central area, perhaps on light bar
Node 1- 3 - Forward, close-out panel upper port wall
Node 1- 4 - Reserved

Actual

NODE 1 RAM - LOCATION 2 INSTALLATION

NODE 1RAM - LOCATION 1 INSTALLATION CLOSE-UP

US LAB



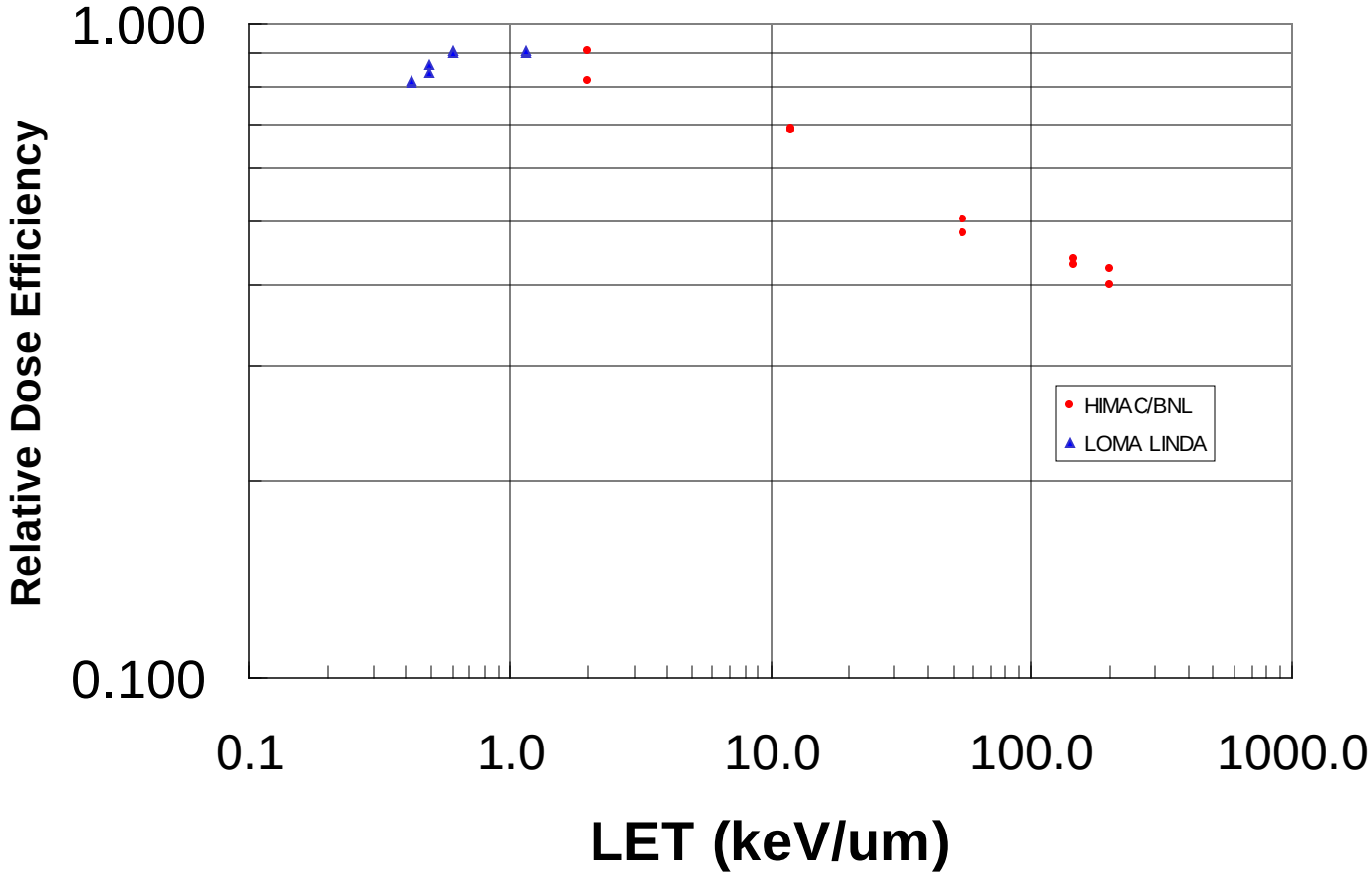
Proposed locations
Lab 1 - Stand off LAX-3 below Rack 5
Lab 2 - Stand off LAX-1 below Rack 2
Lab 3 - Near Lab window, outside hull
Lab 4 - Forward wall near hatch
Lab 5 - Reserved
Lab 6 - Reserved

Under Evaluation

Intercomparisons/Accelerator Calibrations

Particle	Beam Energy/nucleon (MeV/amu)
p	250
p	250
p	200
p	200
p	149
p	149
p	70
p	70
p	70
p	70
He	150
He	150
C	290
C	290
Si	490
Si	490
Fe - BNL	1000
Fe- BNL	1000
Fe	500
Fe	500

High-LET Irradiations



Dosimetry Record Keeping

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Dosimetry Report

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JSC Space Radiation Dosimetry Laboratory	STS-103	Dosimetry Report Date: 12-6-99 Page 2 of 2

Dose Values from TLD Dosimeters
Low-LET (Linear Energy Transfer) Component

Crew Passive Dosimeters (CPD)

Detector: TLD-100 at Depth of 0.18 g/cm^2	Avg. CPD Dose (mrad)	Max. CPD Dose (mrad)	Min. CPD Dose (mrad)

Detector: TLD-100 at 0.18 gm/cm^2			Ground Dose Control (mrad):	±
Dosimeter	Crew Member		EVA	Dose (mrad)
CPD1	CDR	Curtis L. Brown	N	±
CPD2	PLT	Scott J. Kelly	N	±
CPD3	MS1	Steven L. Smith	Y	±
CPD4	MS2	Jean-Francois Clervoy (France/ESA)	N	±
CPD5	MS3	John M. Grunsfeld	Y	±
CPD6	MS4	C. Michael Foale	Y	±
CPD7	MS5	Claude Nicollier (Switzerland/ESA)	Y	±

Comments: Stated uncertainty represents measurement precision, one sigma of the mean, rather than absolute accuracy.

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Detector: TLD-100 at 0.18 gm/cm^2 — Ground Dose Control (mrad): ±

Dosimeter	Crew Member		EVA	Dose (mrad)
CPD1	CDR	Curtis L. Brown	N	±
CPD2	PLT	Scott J. Kelly	N	±
CPD3	MS1	Steven L. Smith	Y	±
CPD4	MS2	Jean-Francois Clervoy (France/ESA)	N	±
CPD5	MS3	John M. Grunsfeld	Y	±
CPD6	MS4	C. Michael Foale	Y	±
CPD7	MS5	Claude Nicollier (Switzerland/ESA)	Y	±

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ISO 9001 Quality Records

- Dosimetry Reports
- Raw Data - All Glow Curves
- Calibration Records - Instruments + Calibration Field
- Task Performance Sheets (TPS) - all configuration information (types/quantities of detectors)

Passive Dosimetry Report combined with Shuttle TEPC results

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JSC Space Radiation Dosimetry Laboratory	STS-103	Dosimetry Report Date: 12-6-99 Page 2 of 2

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Doses calculated from the Linear data (512 channels)

SHUTTLE	GCR	TRAPPED	TOTAL
Dose (μ Gray)	1066.615	629.924	1696.539
Dose Equivalent (60) (μ Sievert)	5490.735	1215.849	6706.584
Dose Equivalent (26) (μ Sievert)	4468.452	1251.759	5720.211
Particles count	1972984.215	1205299.785	3178284.000
Time (minutes)	12118.000	688.000	12806.000
Dose (μ Gray/day)	119.938	70.833	190.771
Dose Equivalent (60)/day (μ Sievert/day)	617.418	136.719	754.137
Dose Equivalent (26)/day (μ Sievert/day)	502.465	140.757	643.222

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