

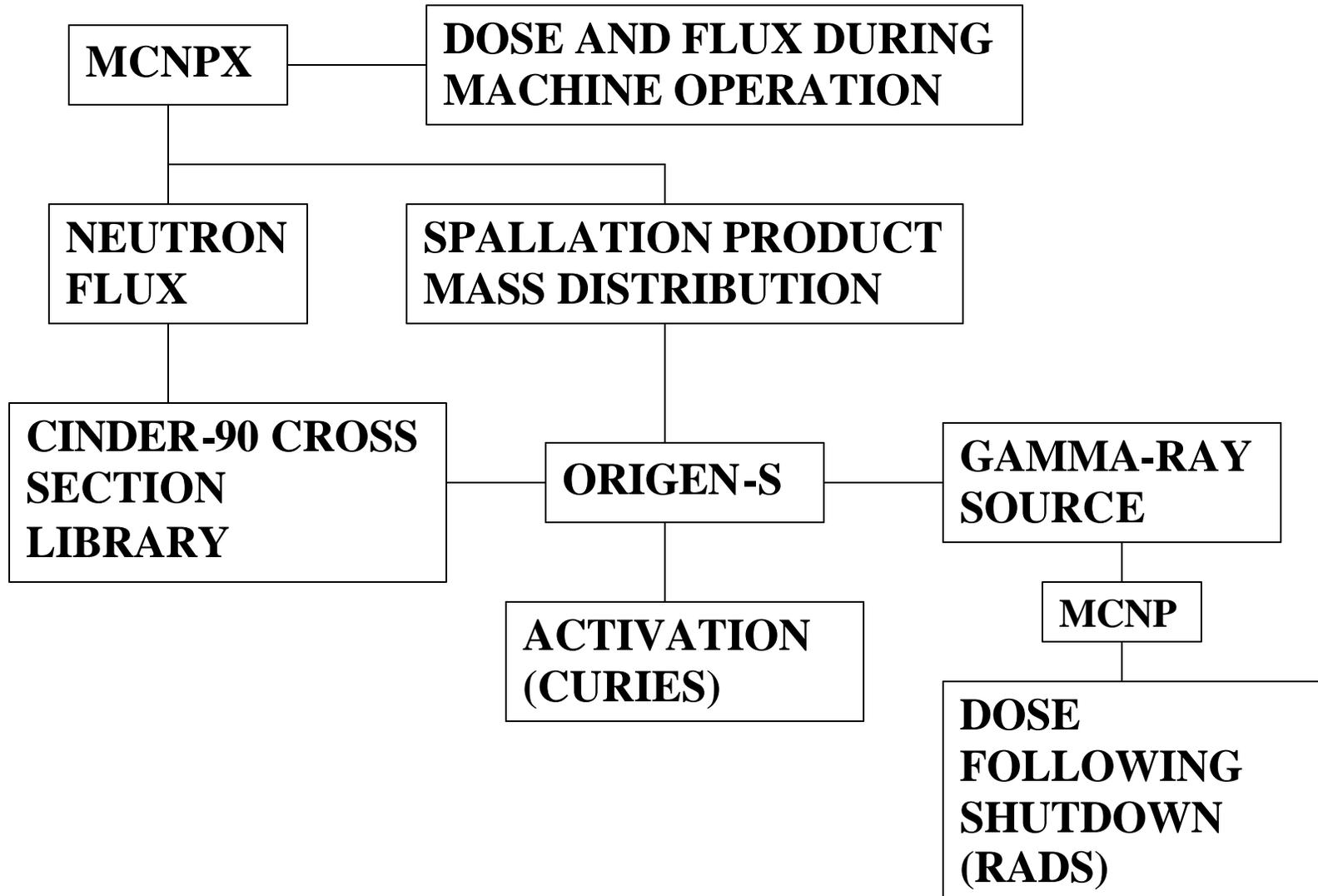
ESTIMATES OF DOSE AND RESIDUAL ACTIVITY IN SNS RING COLLIMATION STRAIGHT

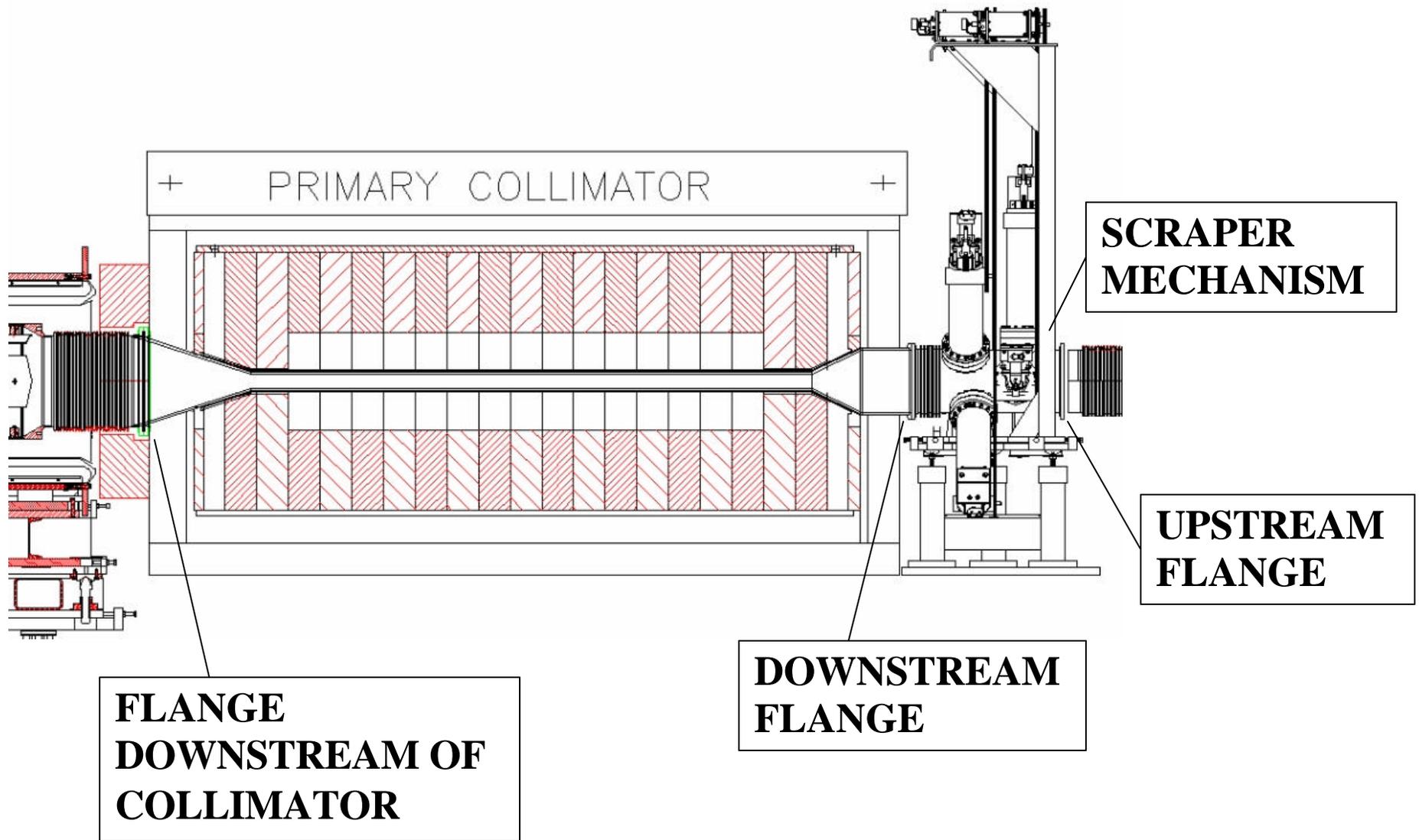
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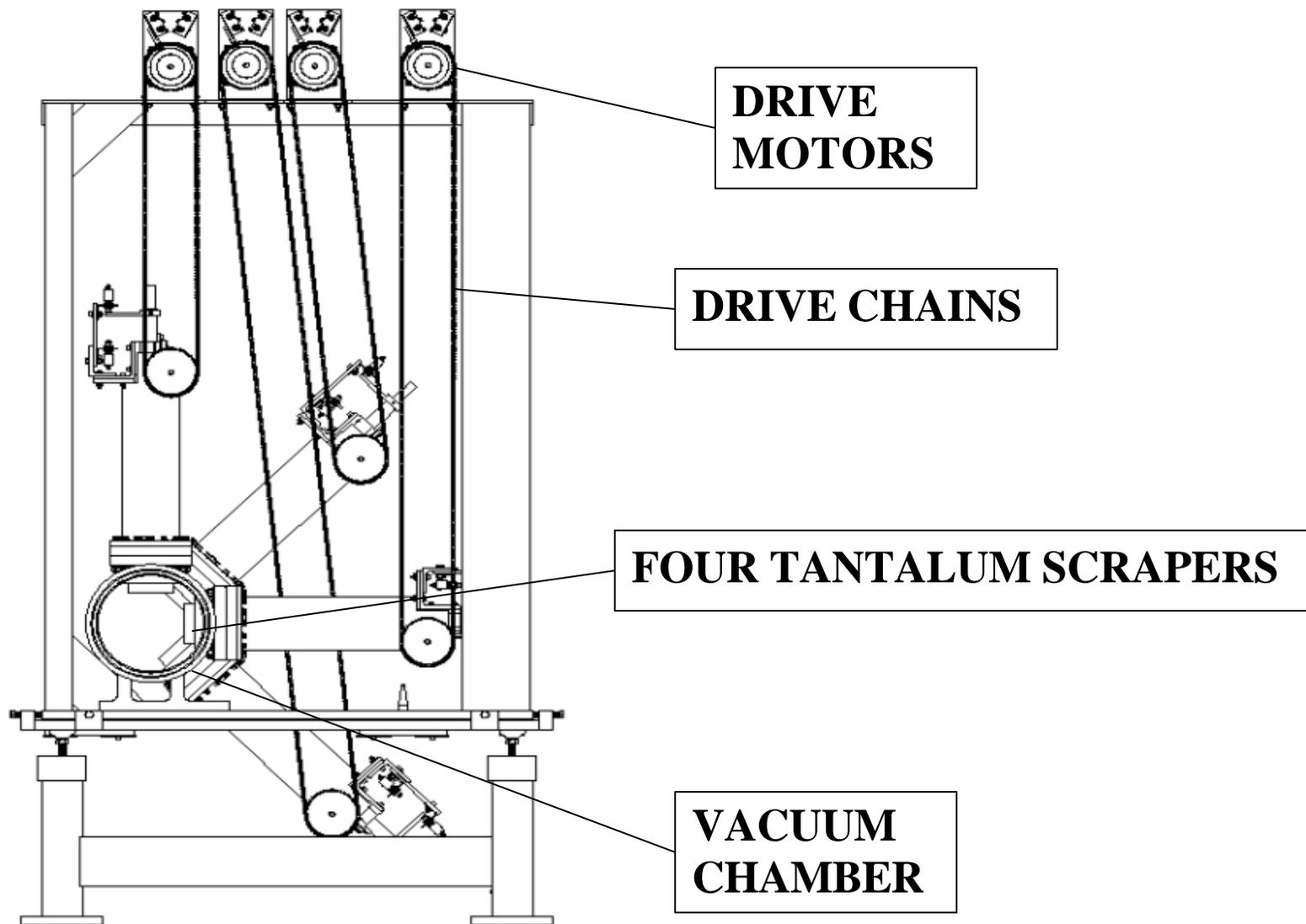
**PRESENTED TO
ICFA ADVANCED BEAM DYNAMICS WORKSHOP
MONTAUK, NEW YORK,
USA.**

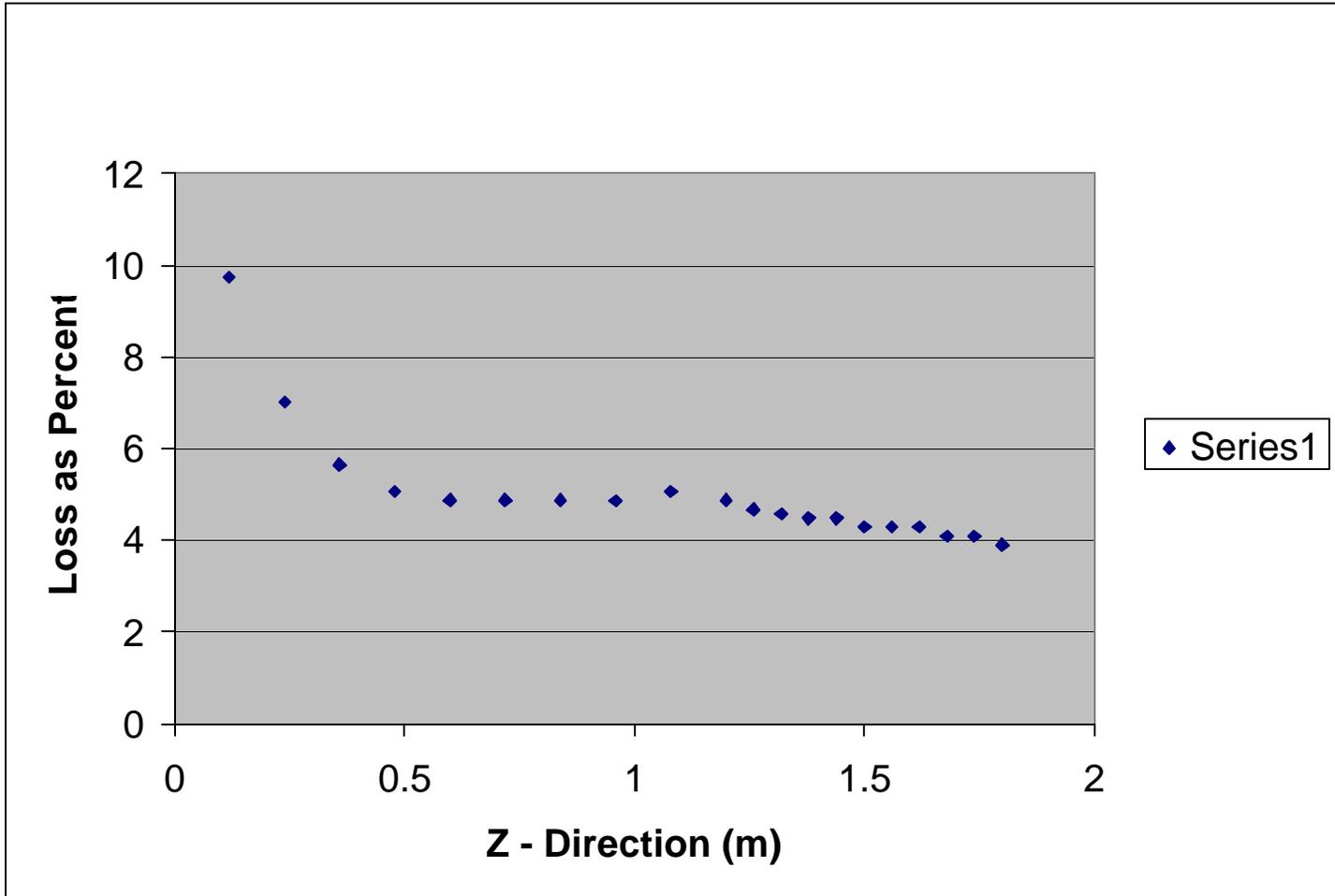
MAY 2003

METHOD OF ANALYSIS









PRIMARY COLLIMATOR LOSS PROFILE

**DOSE WHILE MACHINE IS OPERATING
(RADS/YEAR)**

- ? ASSUME TOTAL RING LOSS 0.001 OF CIRCULATING BEAM**
- ? MACHINE OPERATES FOR ONE YEAR (2.16×10^7 s.) AT 2 MW**

Location Description	Collimator dose	Scraper dose	Total dose
Flange upstream of Scraper	1.20(5)*	1.71(6)	1.83(6)
Flange downstream of Scraper	4.87(5)	7.54(6)	8.03(6)
Flange downstream of Collimator	2.47(7)	~	2.47(7)
Magnet downstream Of Collimator	4.83(7)	~	4.83(7)

***1.20(5) = 1.20×10^5**

**DOSE IMMEDIATELY FOLLOWING MACHINE
SHUTDOWN
(mRADS/HOUR)**

Location Description	Dose
Flange upstream of Scraper	84
Flange downstream of Scraper	5025
Flange downstream of Collimator	490
Magnet downstream of Collimator	790

? FOLLOWING MACHINE SHUTDOWN COLLIMATOR (STAINLESS STEEL AND SCRAPERS (TANTALUM) DECAY AT DIFFERENT RATES – NORMALIZED RATES ARE:

Material	Time following shutdown			
	0.0	4 Hr	7 Days	30 Days
Stainless steel	1.0	0.776	0.537	0.328
Tantalum	1.0	0.462	0.125	0.061

**DOSE TO SCRAPER DRIVE MOTORS WHILE MACHINE IS
OPERATING
(RADS/YEAR)**

- ? IRON SHIELD ASSUMED TO BE ABOVE SCRAPER**
- ? TWO THICKNESSES CONSIDERED FOR SHIELD**

Iron shield thickness (cm)	Dose
15	1.1(5)
30	5.5(4)

- ? DOSE LOW ENOUGH THAT MOTORS SHOULD LAST LIFE OF MACHINE**

COOLING WATER ACTIVATION (CURIES)

- ? ESTIMATE MADE AFTER ONE YEAR OF OPERATION AT 2 MW AND A LOSS FRACTION OF 0.001**
- ? IMMEDIATELY FOLLOWING SHUTDOWN ACTIVATION DOMINATED BY ^{15}O , ^{16}N , ^{11}C , AND ^{12}Be . ALL HAVE SHORT HALF-LIVES.**
- ? AFTER FOUR HOURS DOMINANT NUCLIDES ARE ^7Be AND ^{14}C . ACTIVATION IN CURIES IS:**

Isotope	Activity
Tritium (H-3)	2.6(-8)
Beryllium (Be-7)	6.1(-2)
Carbon (C-14)	2.2(-5)

AIR ACTIVATION ISSUES

- ? ESTIMATE MADE AFTER ONE YEAR OF OPERATION AT 2 MW AND A LOSS FRACTION OF 0.001
- ? IMMEDIATELY FOLLOWING SHUTDOWN ACTIVATION DOMINATED BY ^{13}N , ^{16}N , ^{37}Ar , AND ^{39}Cl ALL HAVE SHORT HALF-LIVES.
- ? AFTER FOUR HOURS ACTIVATION DOMINATED BY ^{10}Be AND ^{14}C .
- ? RATE OF DECAY FOLLOWING SHUTDOWN IS:
(CURIES)

SHUTDOWN	4 HOURS	1 DAY	7 DAYS	30 DAYS
6.445(-2)	4.485(-3)	4.262(-3)	3.902(-3)	2.864(-3)

CABLE DOSE ISSUES

- ? ASSUME CABLE TRAY LOCATED ALONG INSIDE WALL, APPROXIMATELY 1 m ABOVE VACUUM CHAMBER.**
- ? LOSS AROUND PRIMARY COLLIMATOR IS ASSUMED TO BE 35 % OF TOTAL RING LOSS**
- ? MAXIMUM DOSE IS EXPECTED TO BE ~ 210 RADS/HOUR**
- ? ASSUMING A DOSE LIMIT OF 1.0(8) – 5(8) RADS – IMPLIES A LIFE OF ~ 80 YEARS. INCREASES IN THE LOSS FRACTION WILL PROPORTIONATELY REDUCE THIS VALUE.**

CONCLUSIONS

- ? THE LOSS PROFILE IS BIASED TO THE UPSTREAM END, AND THUS AFFECTS THE FLANGE BETWEEN IT AND THE SCRAPER**
- ? THE DOWNSTREAM MAGNETS WILL LIKELY HAVE TO BE CHANGED AT LEAST ONCE DURING THE MACHINE LIFE**
- ? DOSE TO THE SCRAPER DRIVE MOTORS IS LIKELY TO BE SUFFICIENTLY LOW TO ALLOW NO CHANGE DURING THE MACHINE LIFE**
- ? THE COOLING WATER LINES WILL REQUIRE SHIELDING, DUE TO THE ^7Be DECAY**
- ? MAINTENANCE WORK WILL REQUIRE A DECAY TIME OF 1 DAY – 7 DAYS.**