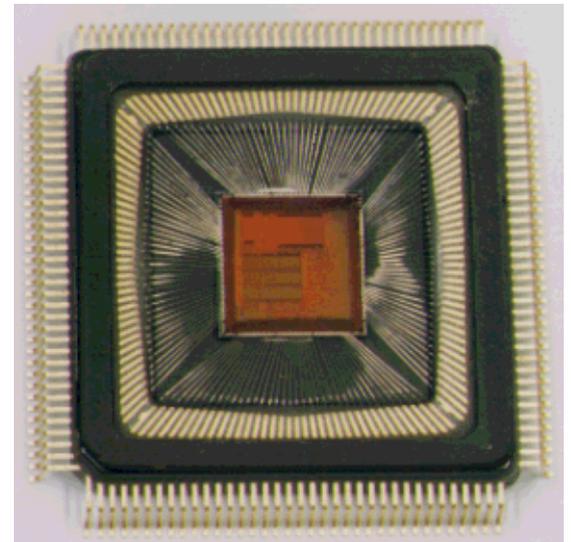




AMT-2: SEE Test and Procurement

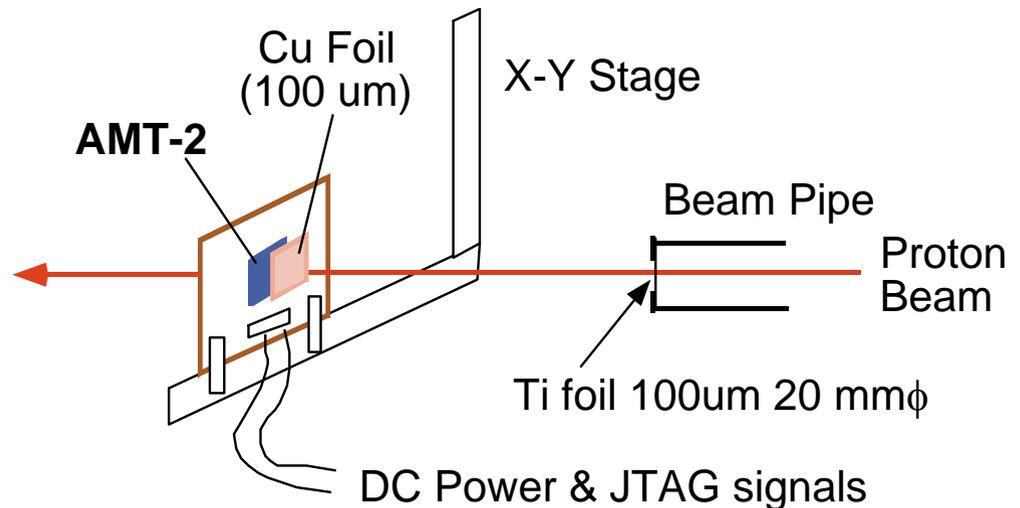
Feb. 26, 2002 @Muon Elec Mtg.
Y. Arai (KEK), yasuo.arai@kek.jp
<http://atlas.kek.jp/tdc/>

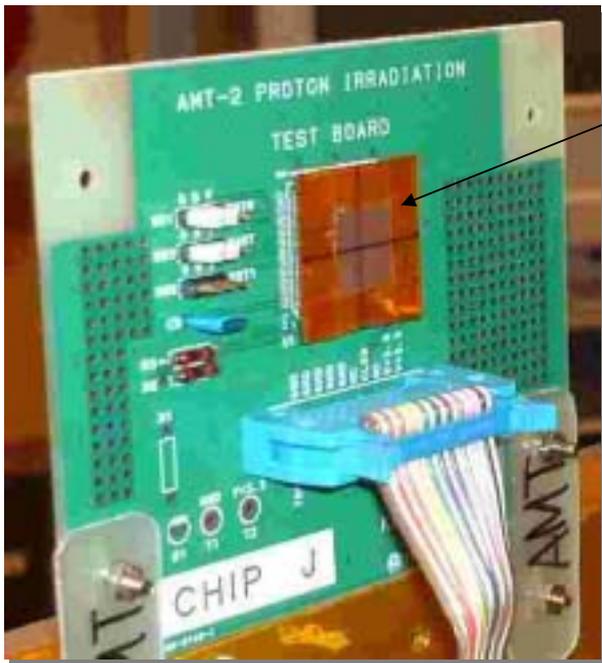
- SEE Test with Proton Beam
- Procurement Schedule



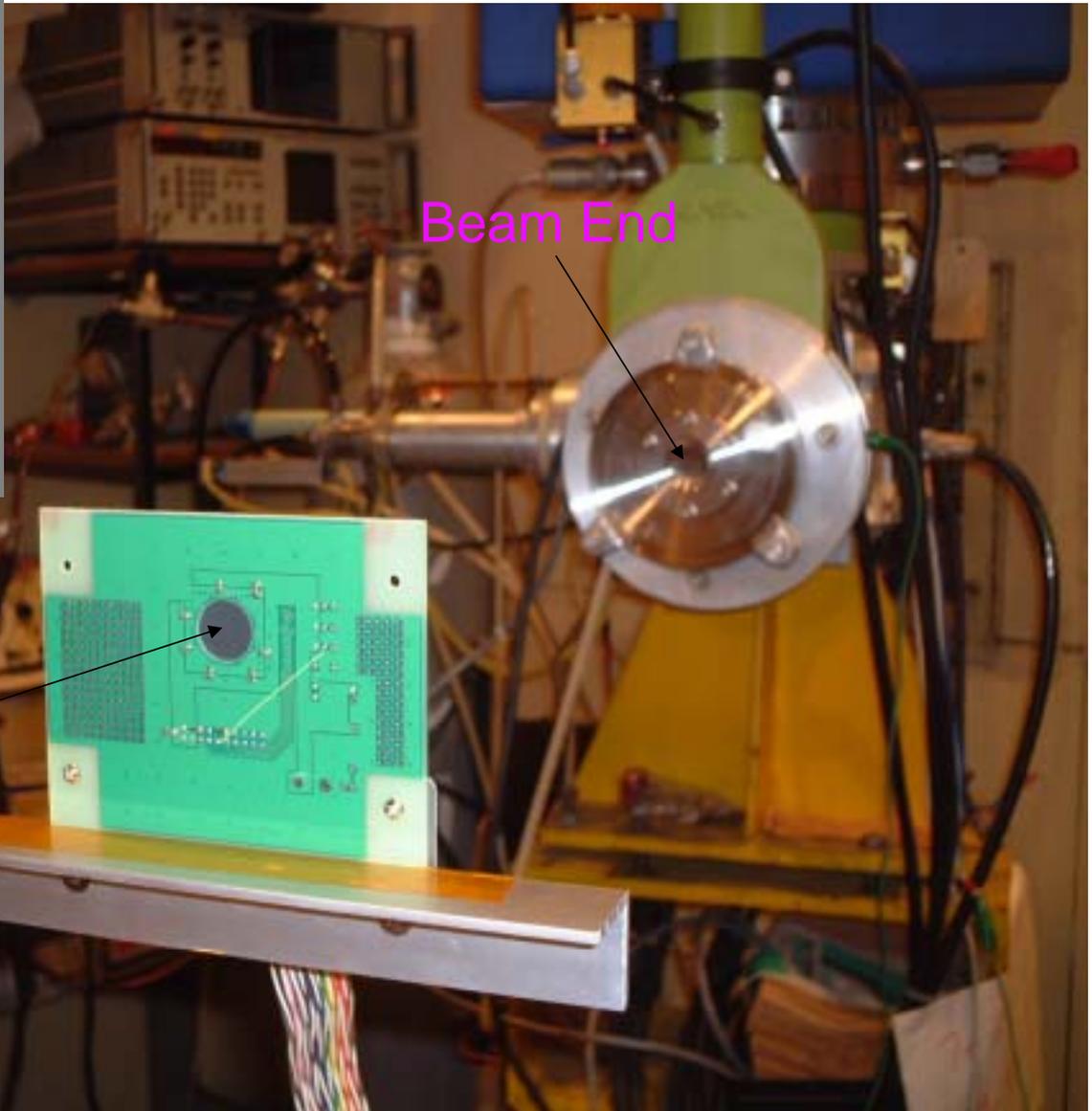
SEE Test : Proton Beam

- AVF Cycrotron (CYRI C, Tohoku Univ.) : $E_{\text{max}}(\text{proton}) = 90\text{MeV}$
- Irradiation were done in Aug. & Dec. with $E(\text{proton}) = 50\text{ MeV}$.
($E(\text{proton}) > 60\text{ MeV}$ were not available due to Cyclotron trouble)
- 2(Aug.) + 3(Dec.) AMT-2 chips were irradiated.
- Beam intensity & profile are monitored with Dosimetry of Cu foil in Dec. run. (In Aug. run, the intensity was estimated from beam current and leak current of AMT-2).





Cu Foil 100 μm

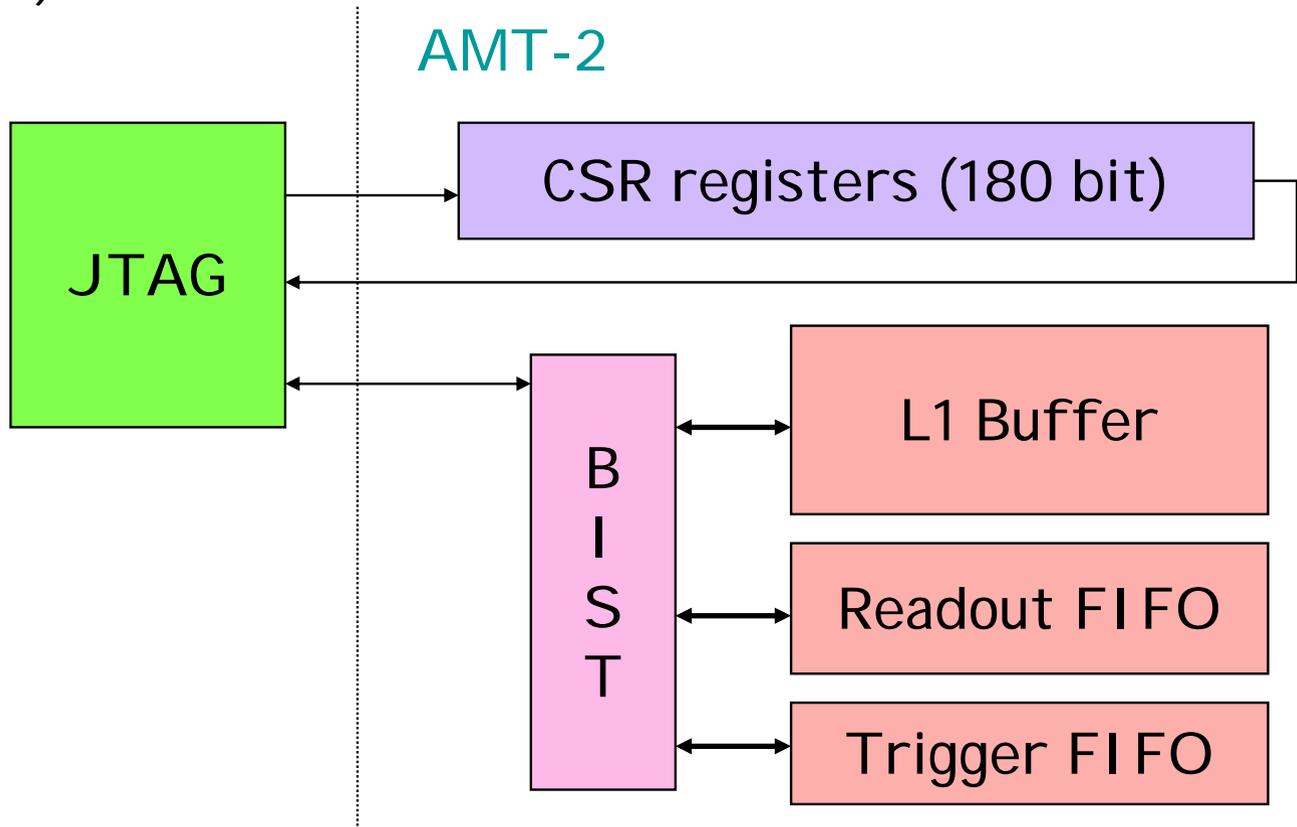


Beam End

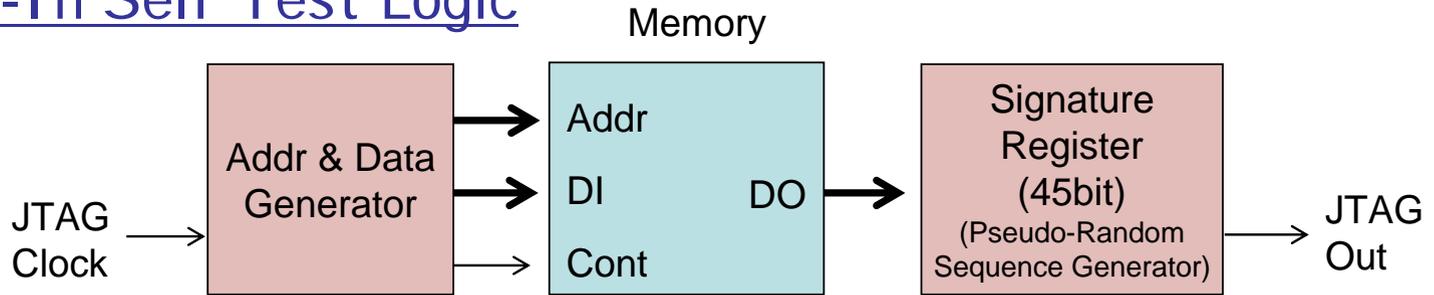
AMT-2

Single Event Upset Test

- CSR registers (180 bits) are directly written/verified through JTAG.
- Data buffers (11,360 bits) are tested by using a Built-In Self-Test (BI ST) circuit.



Built-In Self Test Logic



13N Marching Pattern ('10' & '11' Backgrounds)

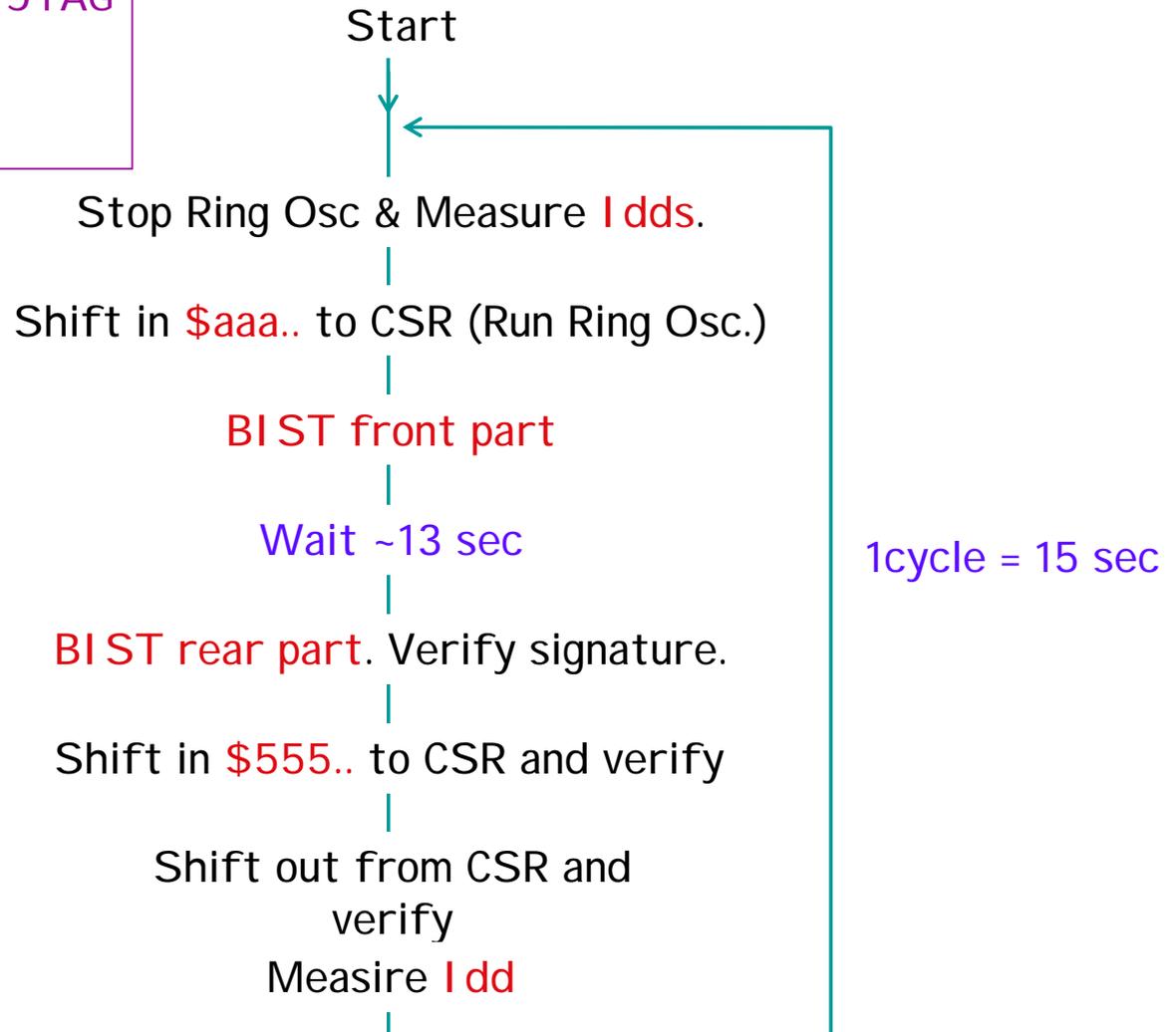
Addr.	Initialize	1st Step	2nd Step	3rd Step	4th Step
0	W(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)
1	W(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)
2	W(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(0)R(1)
:	\	\	\	/	/
N-1	W(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)

Addr.	Initialize	1st Step	2nd Step	3rd Step	4th Step
0	W(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)
1	W(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)
2	W(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)
:	\	\	\	/	/
N-1	W(1)	R(1)W(0)R(0)	R(0)W(1)R(1)	R(1)W(0)R(0)	R(0)W(1)R(1)

Pause

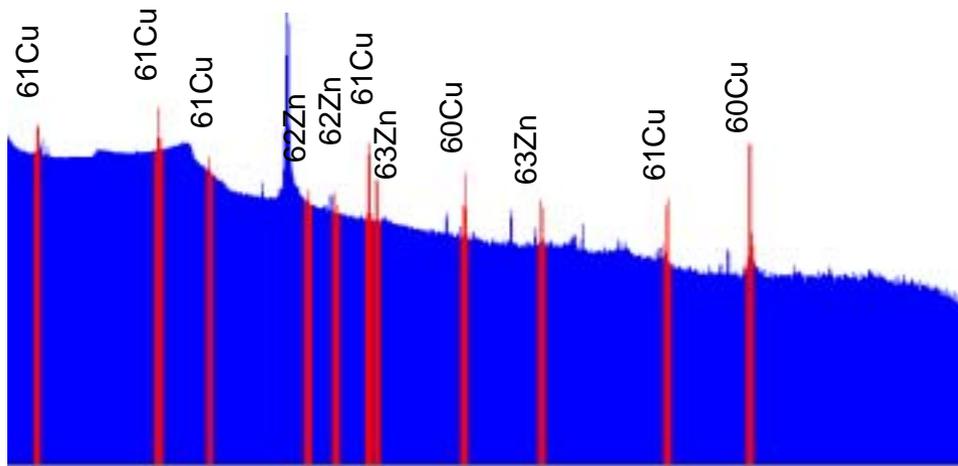
AMT-2 Test sequence

Read/Write through JTAG
Clock is always ON
Power is always ON
Continuous Beam

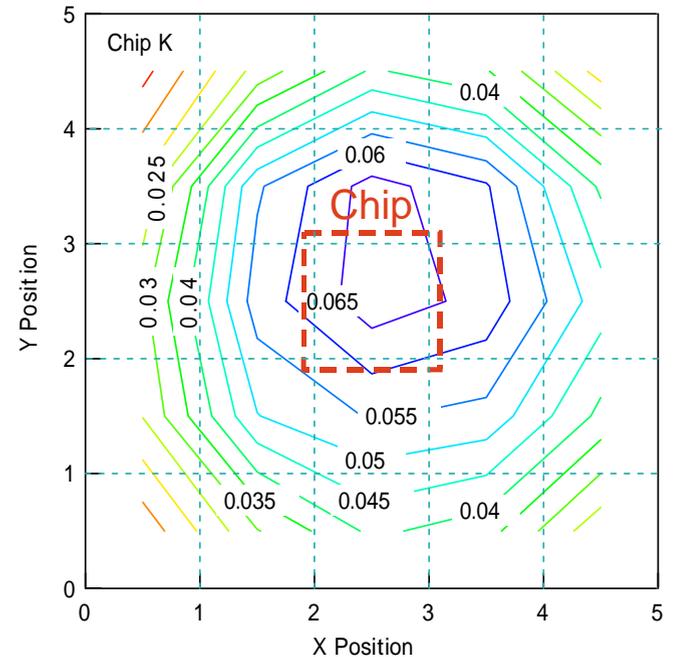


Proton Beam Flux and Profile

- 100 mm thick Cu Foil (25 mm x 25 mm) was placed in front of the AMT-2.
- γ Spectrum was measured with Ge detector to estimate Proton flux.
- Relative intensity of 5 mm x 5 mm pieces were counted with GM counter to measure beam profile.



Gamma Spectrum of Cu Foil



Beam Profile

SEE Test Summary

Run	Chip	P Fluence (1/cm ²)	Dose (krad)	SEU in Mem	$\sigma_{\text{SEU}}(\text{Mem})$ (cm ² /bit)	SEU in CSR	$\sigma_{\text{SEU}}(\text{CSR})$ (cm ² /bit)
Aug.	1	~1.4 E12	~220	1 ^(a)	< 6.3 E -17	0	< 9.7 E-15
	2	~1.0 E12	~160	2 ^(b)	< 1.8 E-16	0	< 1.4 E-14
Dec.	J	5.6 E11	90	0	< 3.8 E-16	0	< 2.4 E-14
	K	5.9 E11	94	0	< 3.6 E-16	0	< 2.3 E-14
	A	4.7 E11	75	0	< 4.6 E-16	0	< 2.9 E-14
	Total	1.6 E12		0	< 1.3 E-16	0	< 8.5E-15
Grand Total		4 E12			< 1.6 E-16		< 3.4 E-15

(a) SEU occurred above 160 krad. (b) SEU occurred above 80 krad and 100 krad.

- Hadron(>20 MeV) Flux < 1E10 h/cm²/year @MDT
- SEU rate < 20 SEU/MDT/year (both for Memory and CSR).
- No Latch Up observed.

AMT-2 Procurement

- Japan-ATLAS group plans to allocate resources to make a complete production of final AMT chips in FY2002 (Apr.2002 - Mar.2003).
- Since this production will cost well over 1 MCHF, the production will be the final one.
- The latest date for decision on production is May 2002.

No. of chips for MDT 16,000

Spare

4,000

Total

20,000 (~1.4 MCHF)

Requirement for PRR (from P. Farthouat)

(1) Prototype performances including tests with the detector

=> Need help from MDT group.

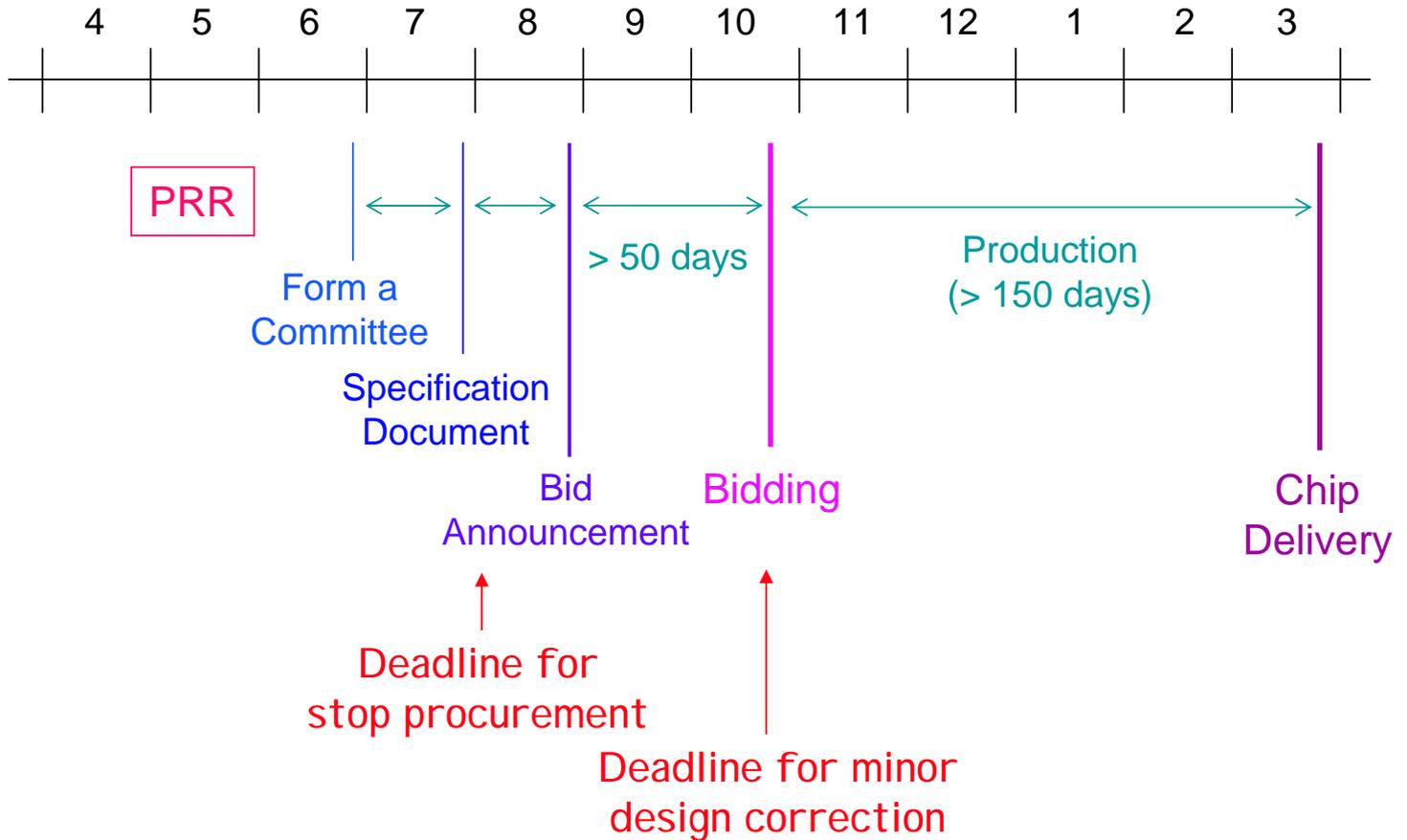
(2) Radiation hardness tests results as defined by the ATLAS policy

=> Tests are in progress. There seems no problem.

(3) Production organization and QA

=> Documentations are being prepared. All functional tests will be done in Toshiba Co. Sampling tests in KEK.

AMT-2 Procurement Schedule (JPN FY 2002)



Summary

- SEE Tests with Proton beam were done. SEU Cross section is less than $1\text{E}14 \text{ cm}^2/\text{bit}$. It seems no problem to be used in MDT.
- Additional γ and proton irradiations are being planned to finish up radiation test report for PRR.
- For mass-production of the AMT-2 in JPN FY2002, PRR must be held in April - May.
- Critical item is a test with fully equipped chamber.