Japan Earthquake
March 11, 2011
2:46 PM

Professor SASA Kimikazu

University of Tsukuba

Greg Norton

NEC

Large Accelerators in Japan over 5 M

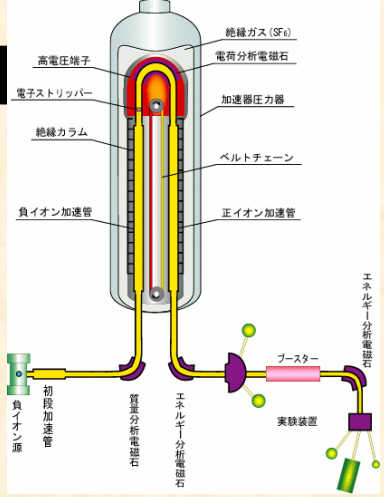
20 MV JAEA Tokai
12 MV Tsukuba University
10 MV Kyushu University
8 MV Kyoto University

---

5 MV Tokyo University
5 MV NIES and Tono Geoscience Center

14 years to 36 years

Operating Domestic Large Tandems



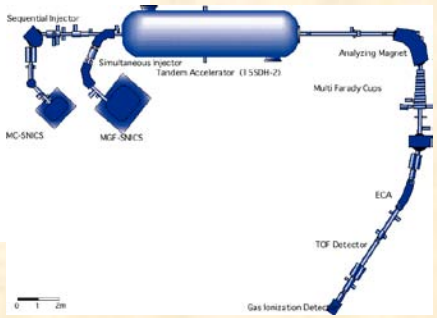
Japan Atomic Energy Agency
20 MV (1982) Materials for Nuclear Physics, Nuclear, Radiochemistry

Kyushu 10MV Tandem (1980)
being shut down

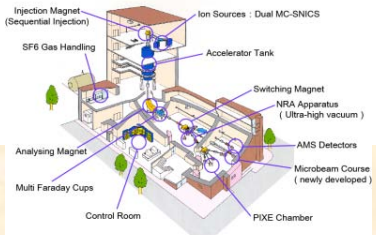
Japan Atomic Energy Agency Tono (1997)
Carbon 14 dating only

University of Tsukuba 12MV (1975)
Generic: MS, Beam analysis, Nuclear Physics, Radiation Processing

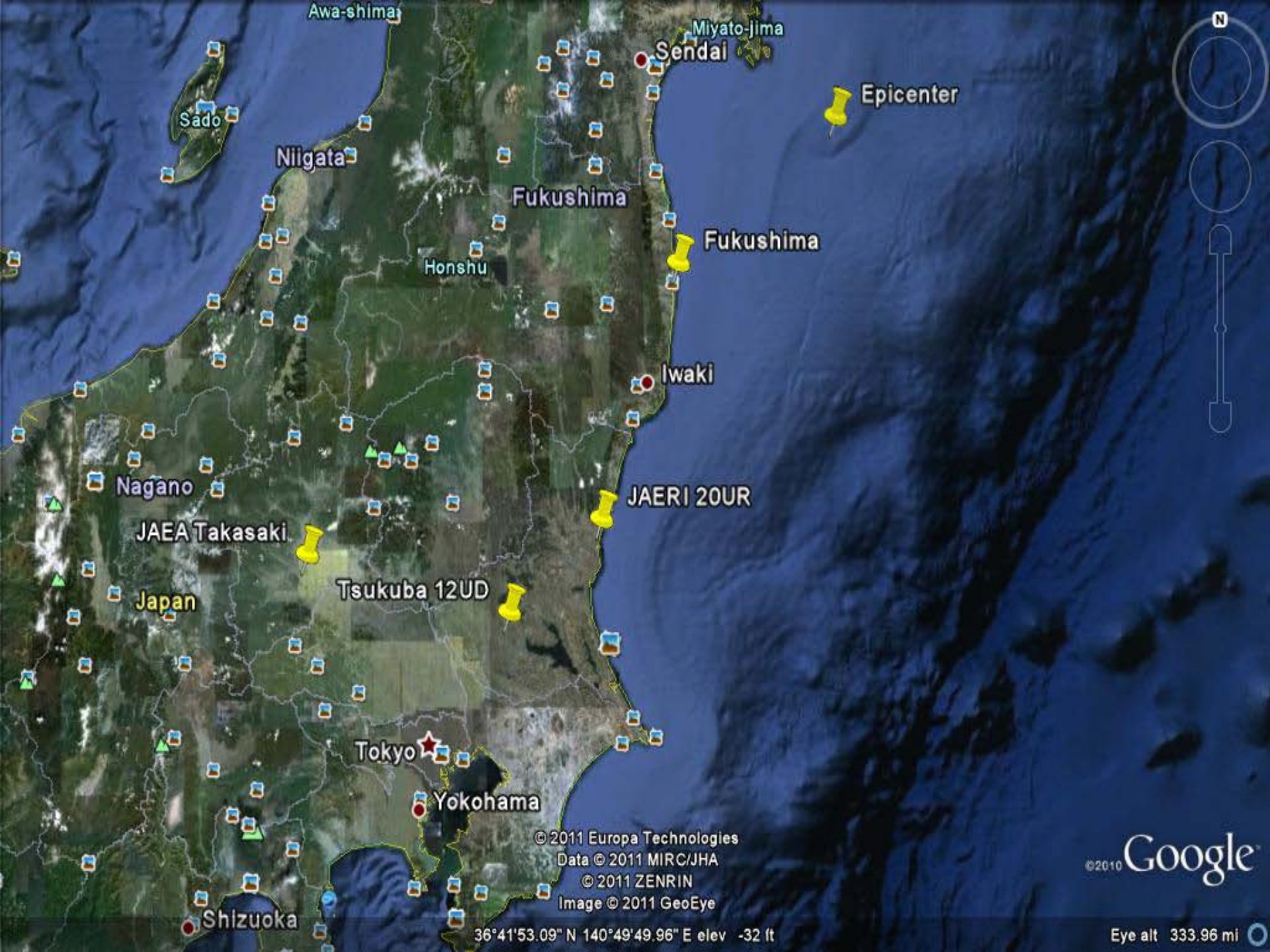
National Institute for Environmental Studies NIES Terra Tandem 5 MV (1995) Carbon 14 dating only



Tokyo University of Tokyo MALT
Tandem 5 MV (1991)
AMS+Beam Analysis



Kyoto 8 MV (1980)
Moving to Kyushu


Awa-shima
Miyato-jima
Sendai
Epicenter
Sado
Niigata
Fukushima
Fukushima
Honshu
Iwaki
Nagano
JAERI 20UR
JAEA Takasaki
Tsukuba 12UD
Japan
Tokyo
Yokohama
Shizuoka
© 2011 Europa Technologies
Data © 2011 MIRC/JHA
© 2011 ZENRIN
Image © 2011 GeoEye
©2010 Google
36°41'53.09" N 140°49'49.96" E elev -32 ft
Eye alt 333.96 mi

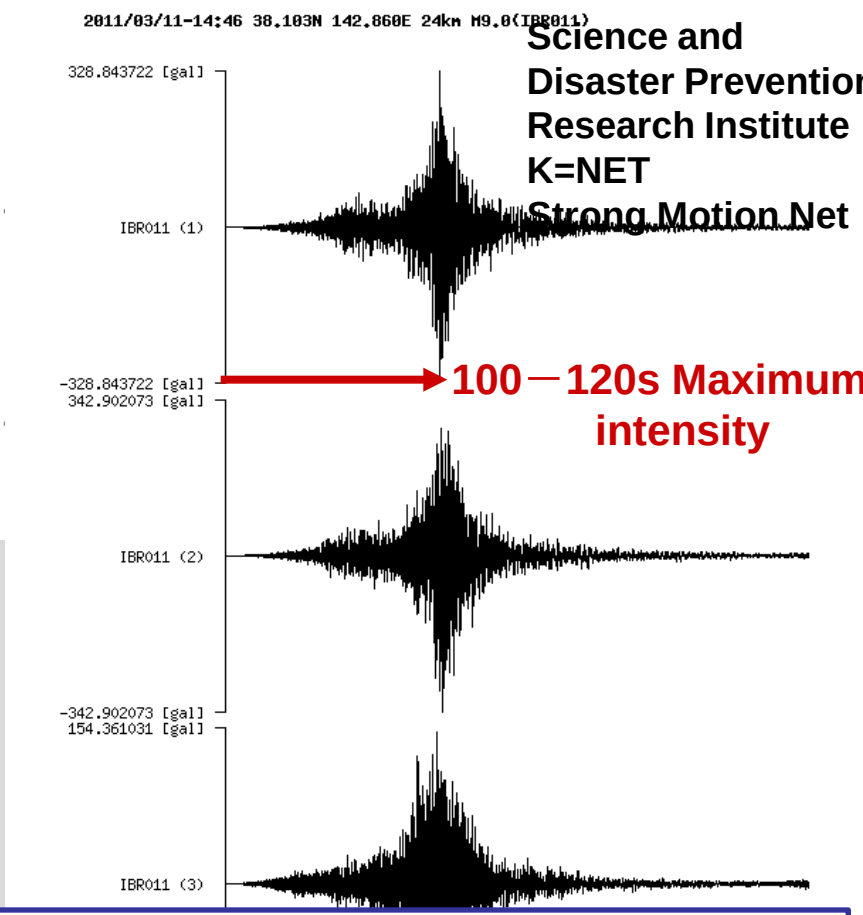
Status of March 11

筑波大学 University of Tsukuba
UTTAC

平成23年東北地方太平洋沖地震

At 14 hours, 46 minutes off Sanriku
JMA seismic intensity of 6 at Tsukuba

K-NET Strong Motion Data
Peak acceleration: 342.9 cm/s^2 (gal)
Record Length: 300 sec.



2011年3月11日 Circumstances of the day

14時47分-

^{41}Ca-AMS measurements underway at 8 MV

Power failure
Evacuation started

15時45分- strong intensity 5
check for injuries
site declared off limits All home

Radio (with batteries) and flashlight are important!

K-NET NIED

3 MV Tandem Pelletron Takasaki

Below Tank

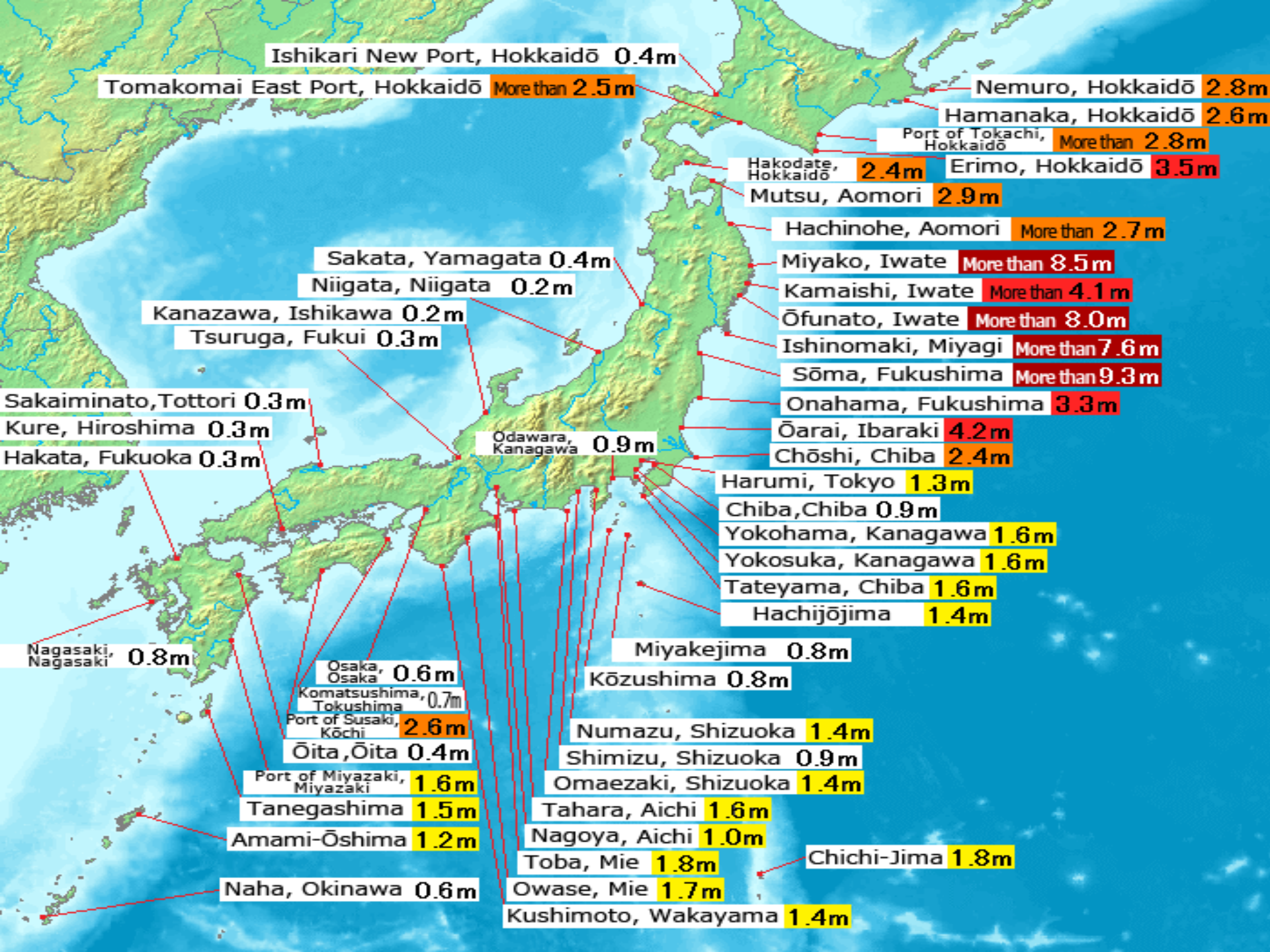
And another bellows

Biggest Worry – JAEA 20UR

- On the coast, 112 km south of Fukushima
- 200 km from the epicenter
- Free standing, single ended column, mostly ceramic, 19.4 meters tall
- In a 23.8 meter tall tank, 8.2 meter diameter

- Very poor mass distribution


JAERI 20UR
Lab only 660 meters from coast
© 2011 Geocentre Consulting
© 2011 ZENRIN
Gray Buildings © 2008 ZENRIN
©2010 Google
Imagery Date: 3/28/2011
2003
36°27'50.36" N 140°36'13.03" E elev 96 ft
Eye alt 6851 ft


Ishikari New Port, Hokkaidō 0.4m
Tomakomai East Port, Hokkaidō More than 2.5m
Nemuro, Hokkaidō 2.8m
Hamanaka, Hokkaidō 2.6m
Port of Tokachi, Hokkaidō More than 2.8m
Hakodate, Hokkaidō 2.4m
Erimo, Hokkaidō 3.5m
Mutsu, Aomori 2.9m
Hachinohe, Aomori More than 2.7m
Sakata, Yamagata 0.4m
Niigata, Niigata 0.2m
Kanazawa, Ishikawa 0.2m
Tsuruga, Fukui 0.3m
Miyako, Iwate More than 8.5m
Kamaishi, Iwate More than 4.1m
Ōfunato, Iwate More than 8.0m
Ishinomaki, Miyagi More than 7.6m
Sōma, Fukushima More than 9.3m
Onahama, Fukushima 3.3m
Ōarai, Ibaraki 4.2m
Chōshi, Chiba 2.4m
Sakaiminato,Tottori 0.3m
Kure, Hiroshima 0.3m
Hakata, Fukuoka 0.3m
Odawara, Kanagawa 0.9m
Harumi, Tokyo 1.3m
Chiba,Chiba 0.9m
Yokohama, Kanagawa 1.6m
Yokosuka, Kanagawa 1.6m
Tateyama, Chiba 1.6m
Hachijōjima 1.4m
Nagasaki, Nagasaki 0.8m
Miyakejima 0.8m
Osaka, Osaka 0.6m
Kōzushima 0.8m
Komatsushima, Tokushima 0.7m
Port of Susaki, Kōchi 2.6m
Numazu, Shizuoka 1.4m
Ōita,Ōita 0.4m
Shimizu, Shizuoka 0.9m
Port of Miyazaki, Miyazaki 1.6m
Omaezaki, Shizuoka 1.4m
Tanegashima 1.5m
Tahara, Aichi 1.6m
Amami-Ōshima 1.2m
Nagoya, Aichi 1.0m
Toba, Mie 1.8m
Chichi-Jima 1.8m
Naha, Okinawa 0.6m
Owase, Mie 1.7m
Kushimoto, Wakayama 1.4m

20 UR Column

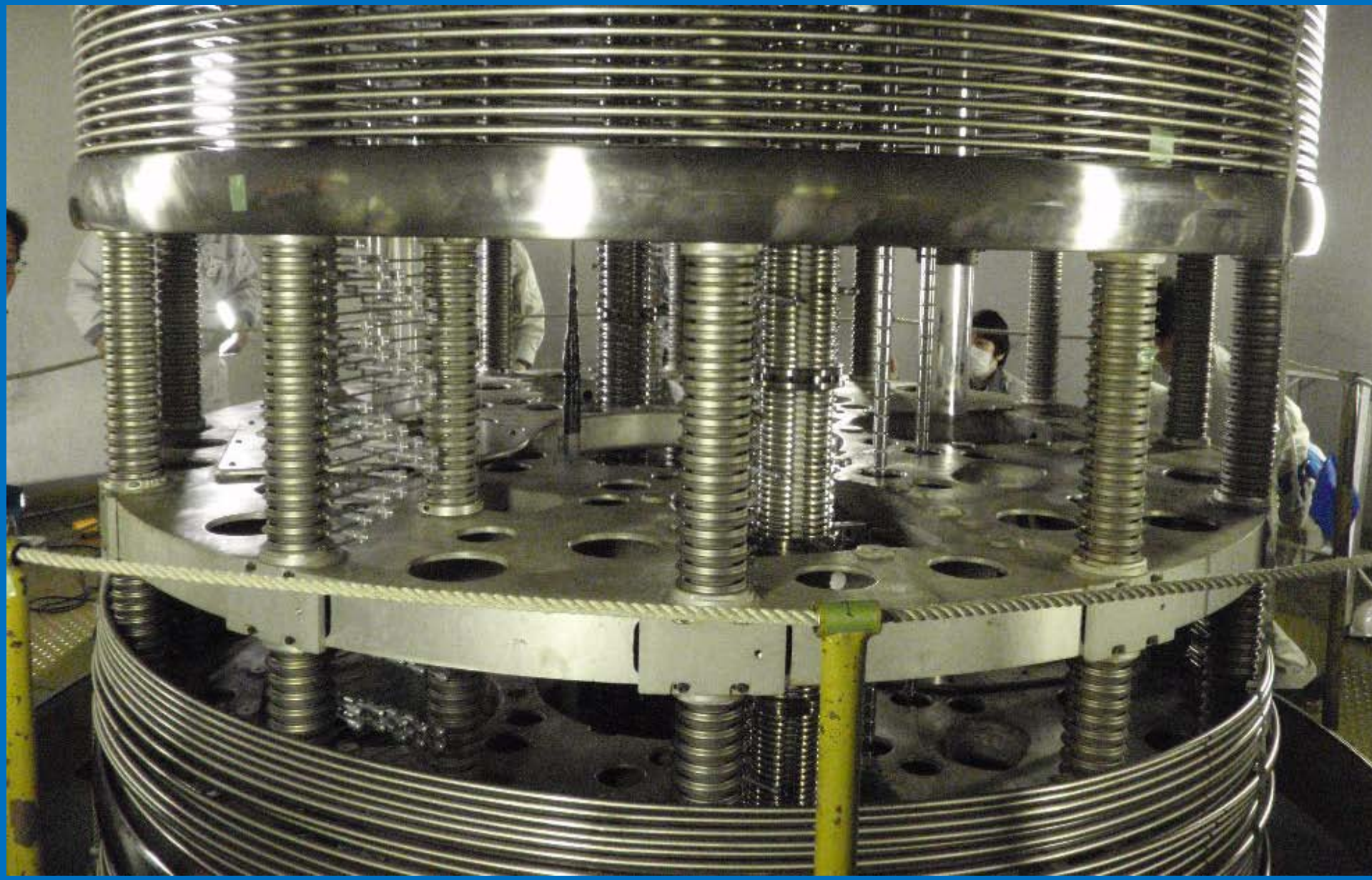
2.74 m diameter
4 m diameter terminal
19.4 m height

180 degree magnet with C.G. at 17.5 m above tank base
11,000 kg

Passive protection system


Stiffness of 10 tons/meter
Damper of 10 tons/m/sec
Move 10 cm in any direction

30 40 50 60 70 80 90 100 110 120 130 140 150
STAINLESS HARDENED
150 mm
1級



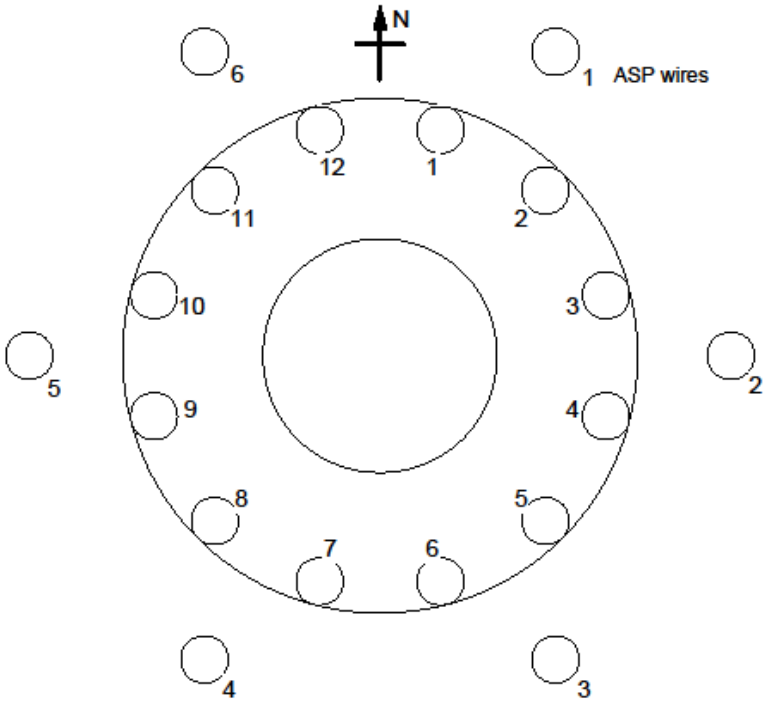
Column Support Post

Full cantilever stress test = 75 kg each post

. 136 kg each 20th post

	Post Number												Crack	Stain
	1	2	3	4	5	6	7	8	9	10	11	12	X	Δ
20						X							1	
19		X											1	
18							X		X				2	
17		X	X	X	X	X							5	
16		X											1	
15			X		X	X			X		X		5	
14		X		X									2	
13						X							1	
12		Δ									X	X	2	1
11	X												1	
10													0	
9	X												1	
8			X		X								2	
7	X		X	X									3	
6								X	X			Δ	3	1
5				X								Δ	1	
4		X			X					?		X	4?	1
3												X	1	
2		X	X							X			3	
1													0	

X : replaced



Support Post Damage in the 20 UR

39 posts out of 240 show cracks in ceramic

No report of acceleration tube damage

SF_6 gas not lost

September, 2011

- Most (all) damaged posts replaced.
- Bottom support ring recentered

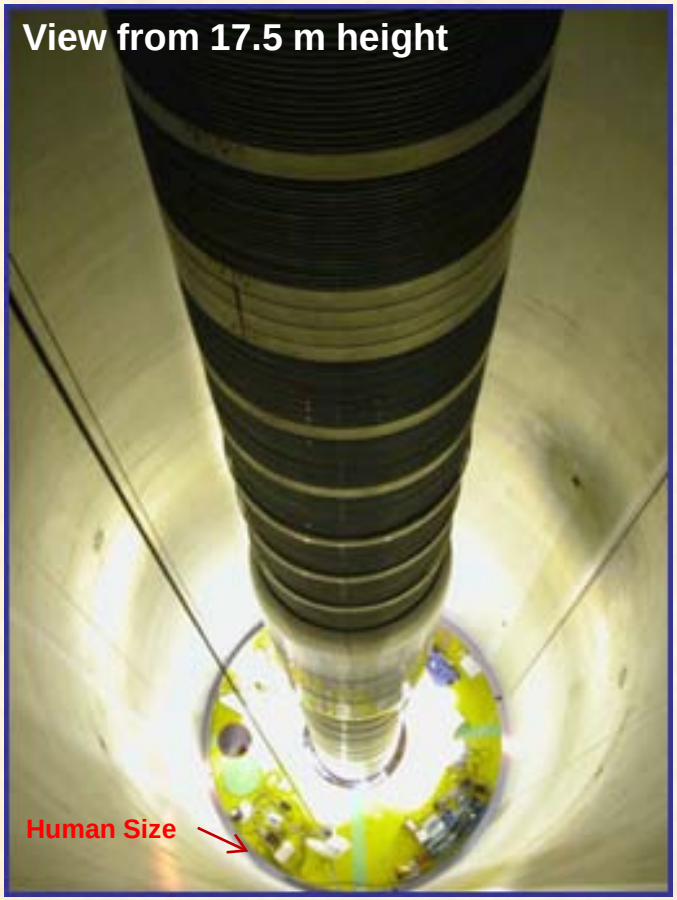
- Run beam at 10 MV

Not A Big Worry – Tsukuba 12 UD

- Inland – 44 km from the coast and over 160 km from Fukushima
- 270 km from the epicenter
- Conventional, Vertical Tandem
- In a 20 meters tall, 4.9 meter diameter tank

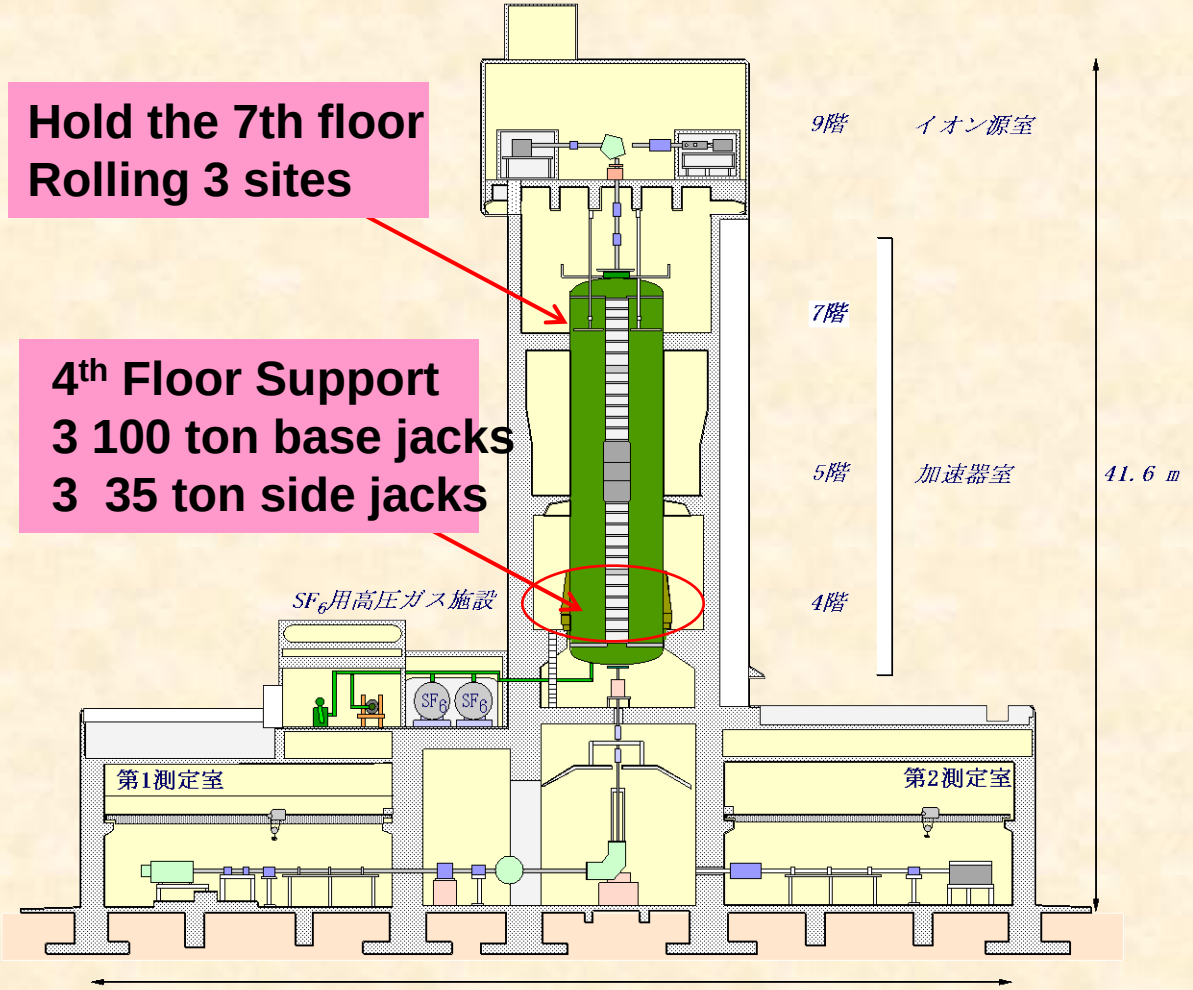
- With active earthquake protection system

University of Tsukuba 12UD Tandem Pelletron Accelerator



Hold the 7th floor
Rolling 3 sites

4th Floor Support
3 100 ton base jacks
3 35 ton side jacks



12UD tandem Pelletron made in 1975
Accelerator voltage: 12 MV (Japan's highest)
Building height : 41.6 m
Accelerator tank: 17.9 m height
4.8 m diameter
120 tons gross weight

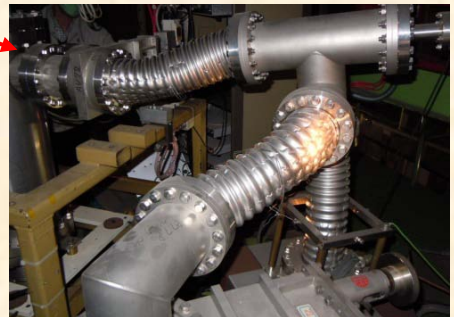
Accelerator Collapse view from 17.9 meters
(2011年3月23日確認)

筑波大学タンデム加速器 施設被災状況

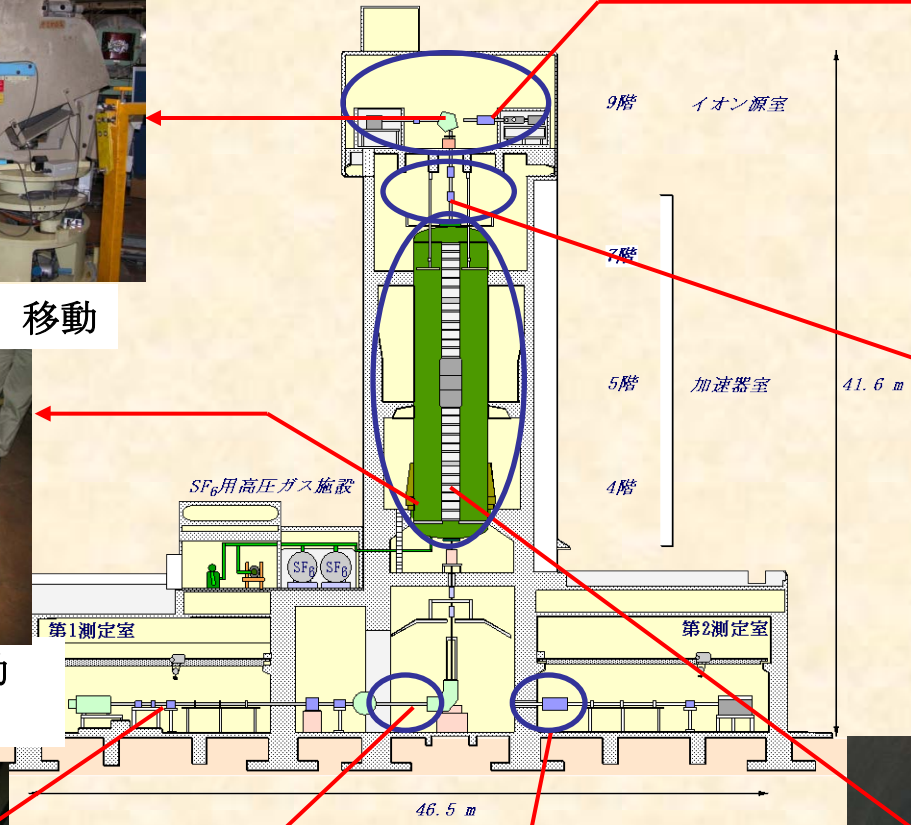
9階入射電磁石　移動

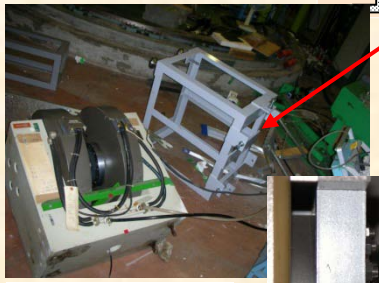
9階　イオン源装置の2台損壊
(真空排気装置は全損)

4階　加速器本体振動
固定具破損

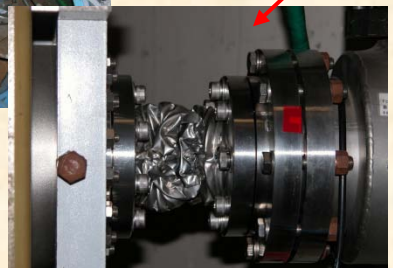


2－3階, 7階　真空ライン破損





電磁石倒壊



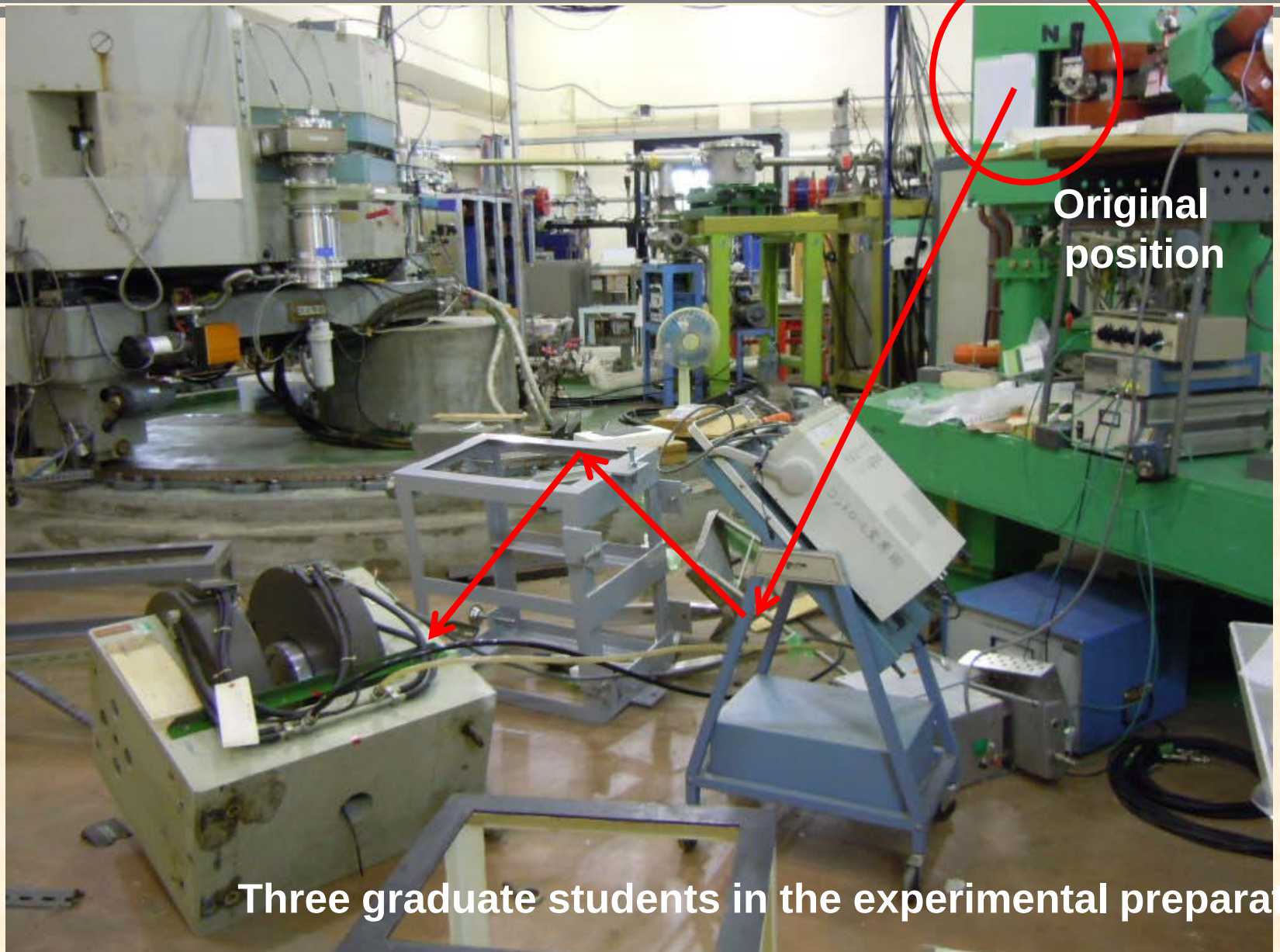
分析電磁石ベローズ破断

測定室電磁石移動

震災により加速器内部が崩壊

The first measuring chamber magnet falling 800 kg

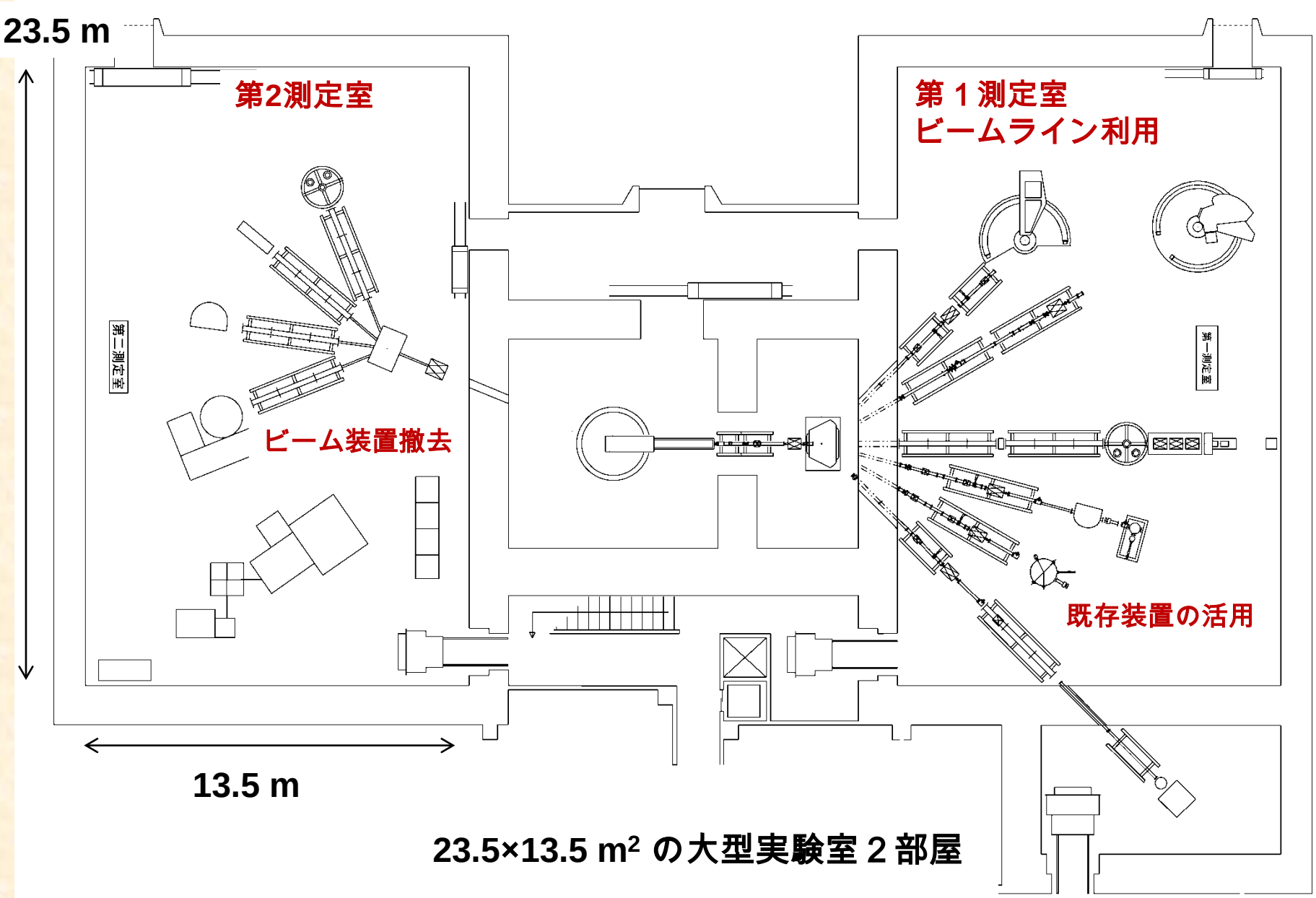
筑波大学 University of Tsukuba
UTTAC



Decisions

- Tank not vertical – 12 UD not to be replaced
- New Accelerator in one of the target rooms

First floor plan view Accelerator Applications Division (now)

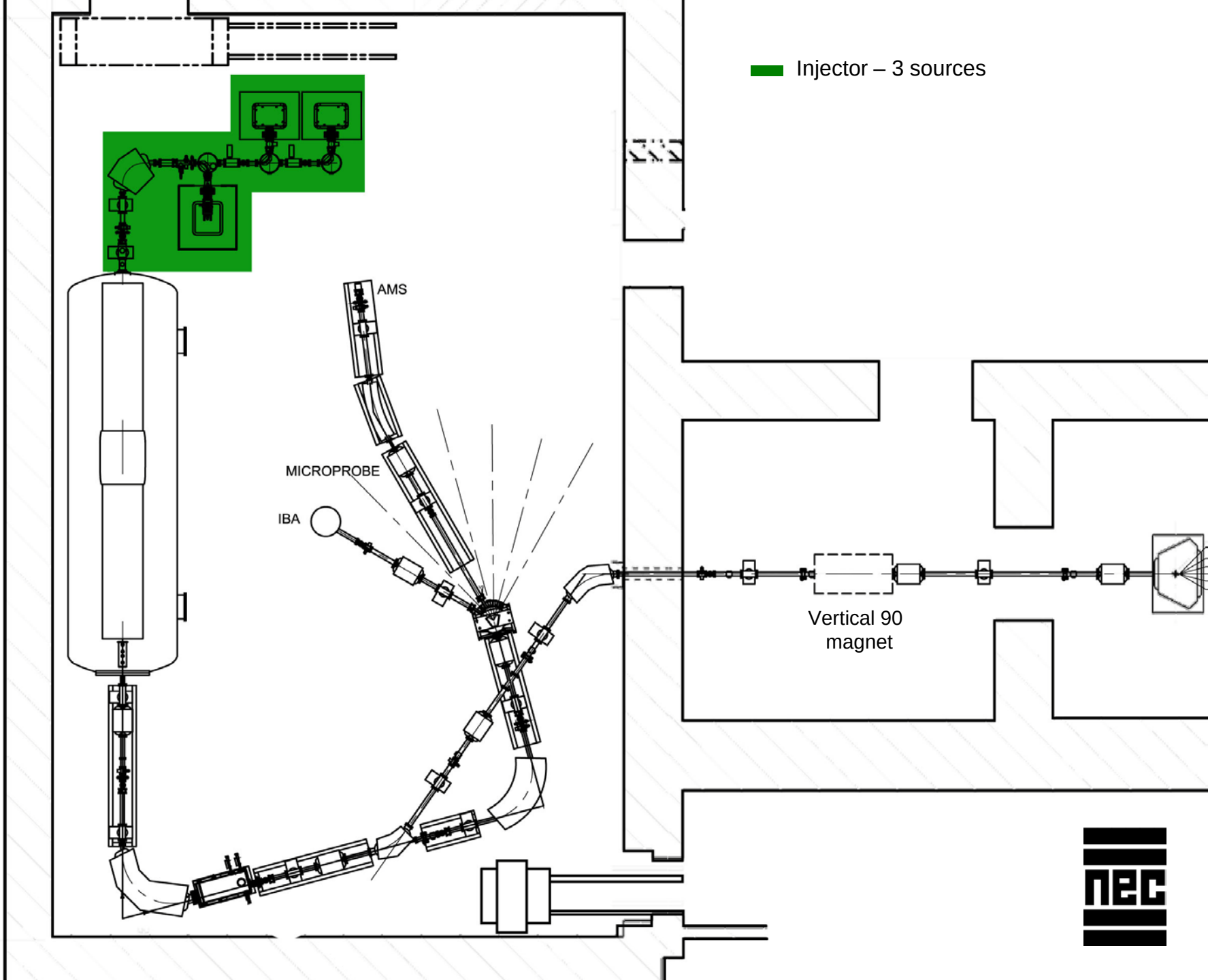


23.5×13.5 m² の大型実験室 2 部屋

Proposed Tandem Pelletron for the Tandem Accelerator Facility at the University of Tsukuba

- 6MV Tandem Pelletron
- Three Ion Source Injector
- Full AMS Capability
- Full IBA Capability
- Connection to Existing Beam Lines
- Ports for Future Beam Lines (microprobe)

Highly Versatile

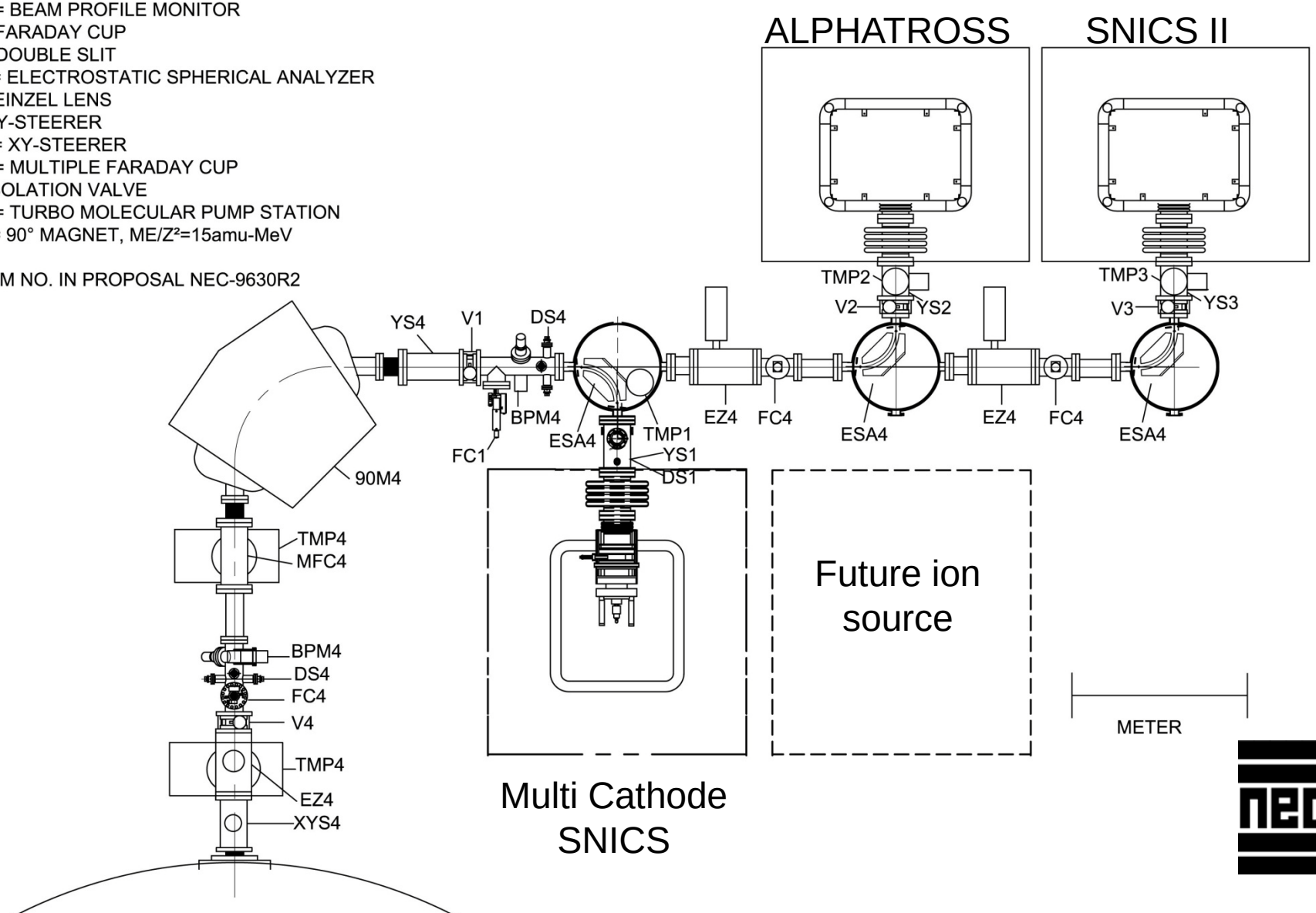

Injector – 3 sources
AMS
MICROPROBE
IBA
Vertical 90
magnet

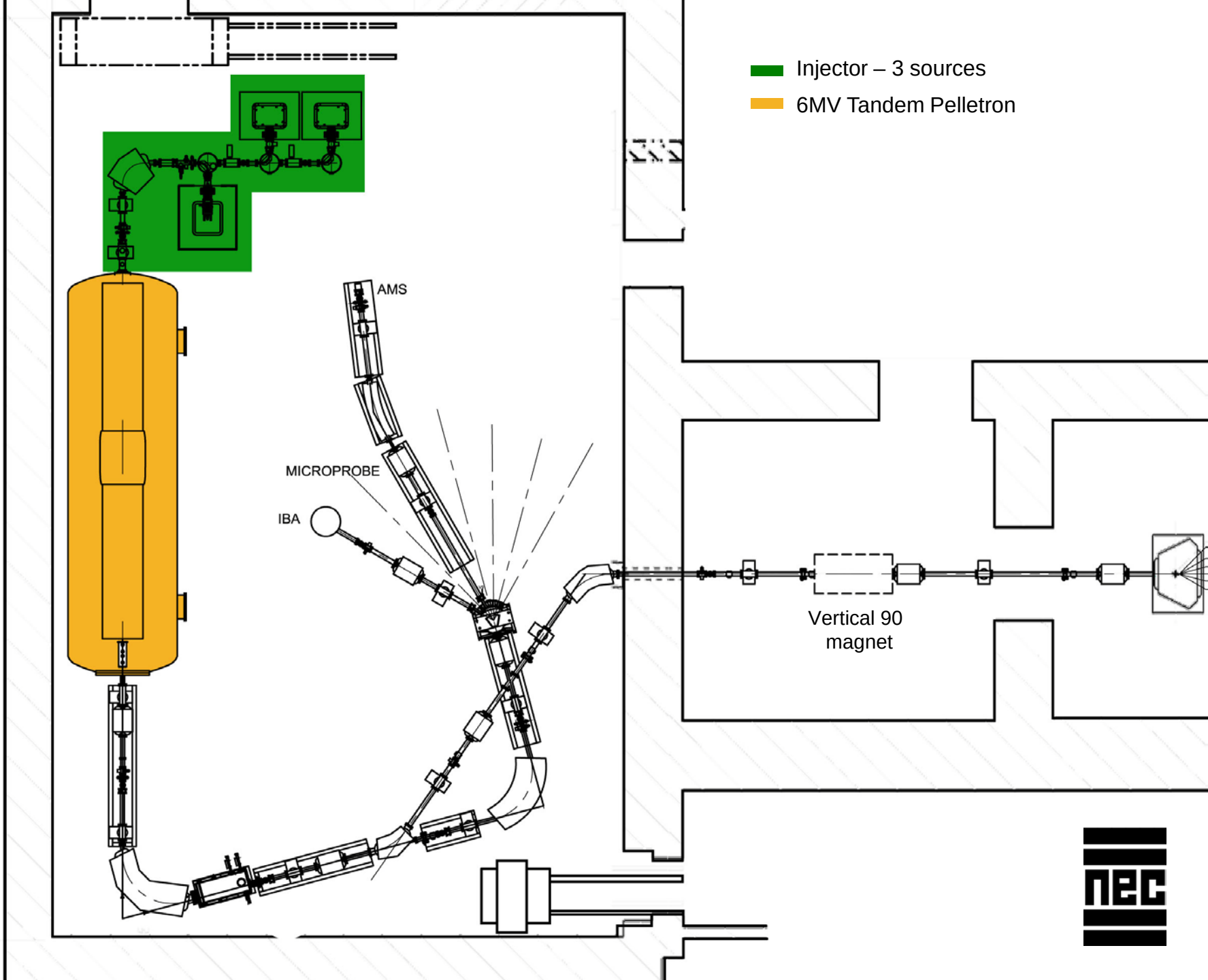
Negative Ion Injector

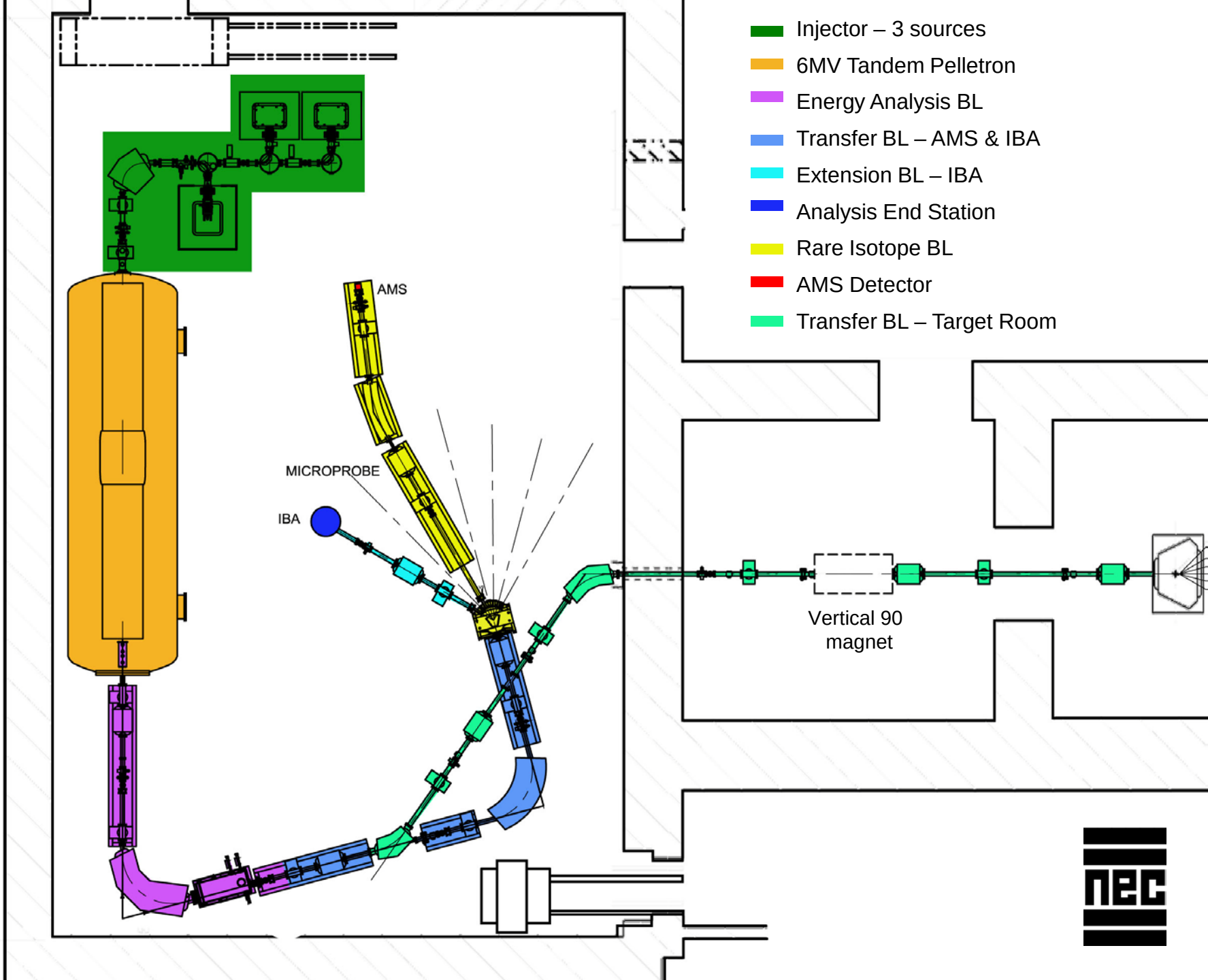
PROPSAL NEC-9630R2

BPMx = BEAM PROFILE MONITOR
FCx = FARADAY CUP
DSx = DOUBLE SLIT
ESAx = ELECTROSTATIC SPHERICAL ANALYZER
EZx = EINZEL LENS
YSx = Y-STEERER
XYSx = XY-STEERER
MFCx = MULTIPLE FARADAY CUP
Vx = ISOLATION VALVE
TMPx = TURBO MOLECULAR PUMP STATION
90Mx = 90° MAGNET, ME/Z²=15amu-MeV

x = ITEM NO. IN PROPOSAL NEC-9630R2




Injector – 3 sources
6MV Tandem Pelletron
AMS
MICROPROBE
IBA
Vertical 90
magnet

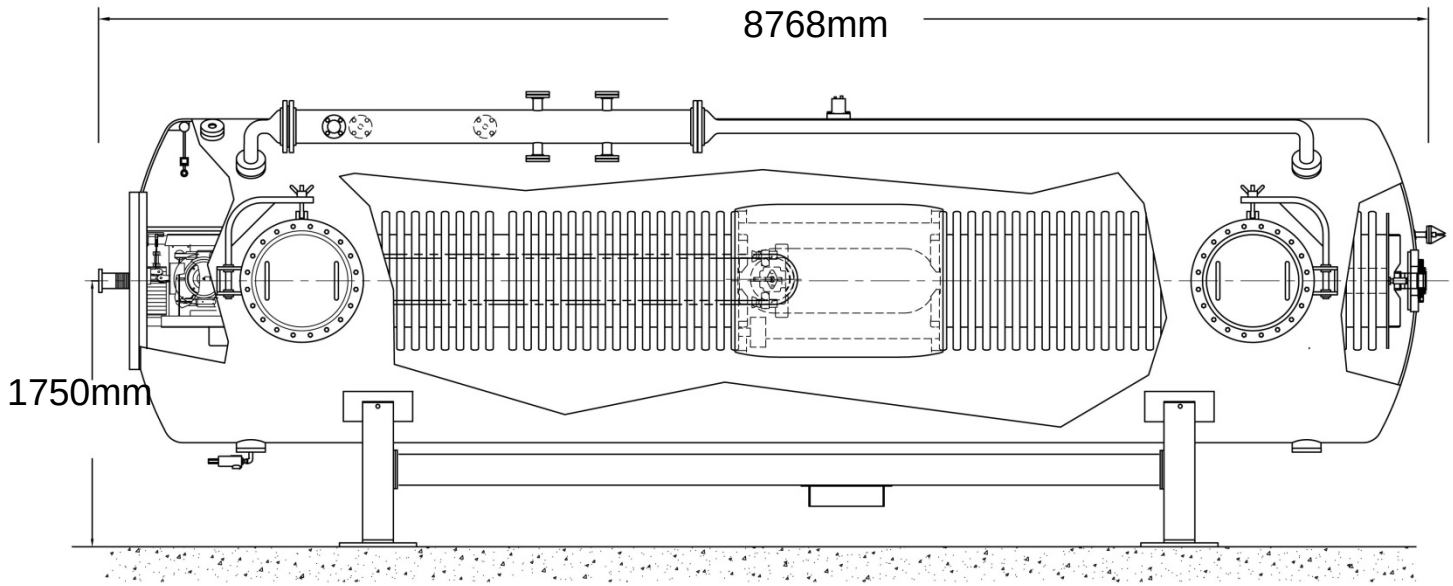

Injector – 3 sources
6MV Tandem Pelletron
Energy Analysis BL
Transfer BL – AMS & IBA
Extension BL – IBA
Analysis End Station
Rare Isotope BL
AMS Detector
Transfer BL – Target Room
AMS
MICROPROBE
IBA
Vertical 90
magnet

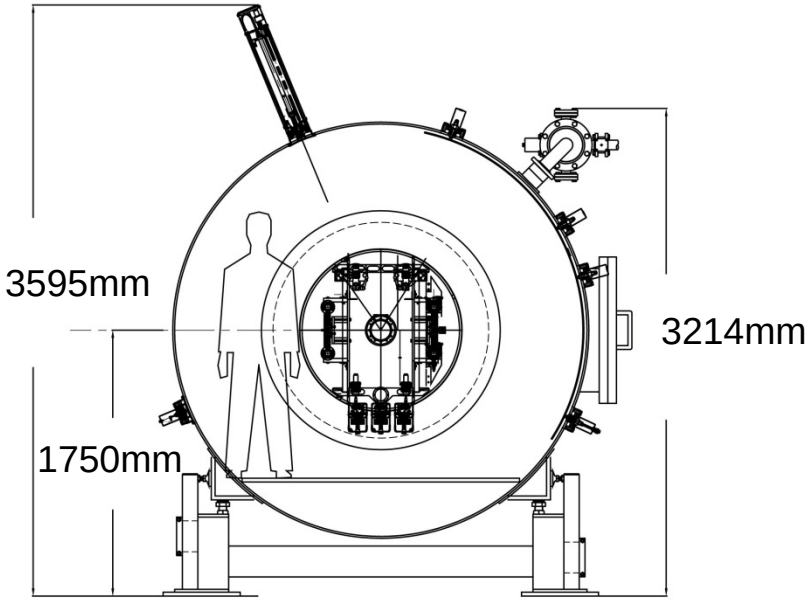
Thank You

NEC AMS Control System

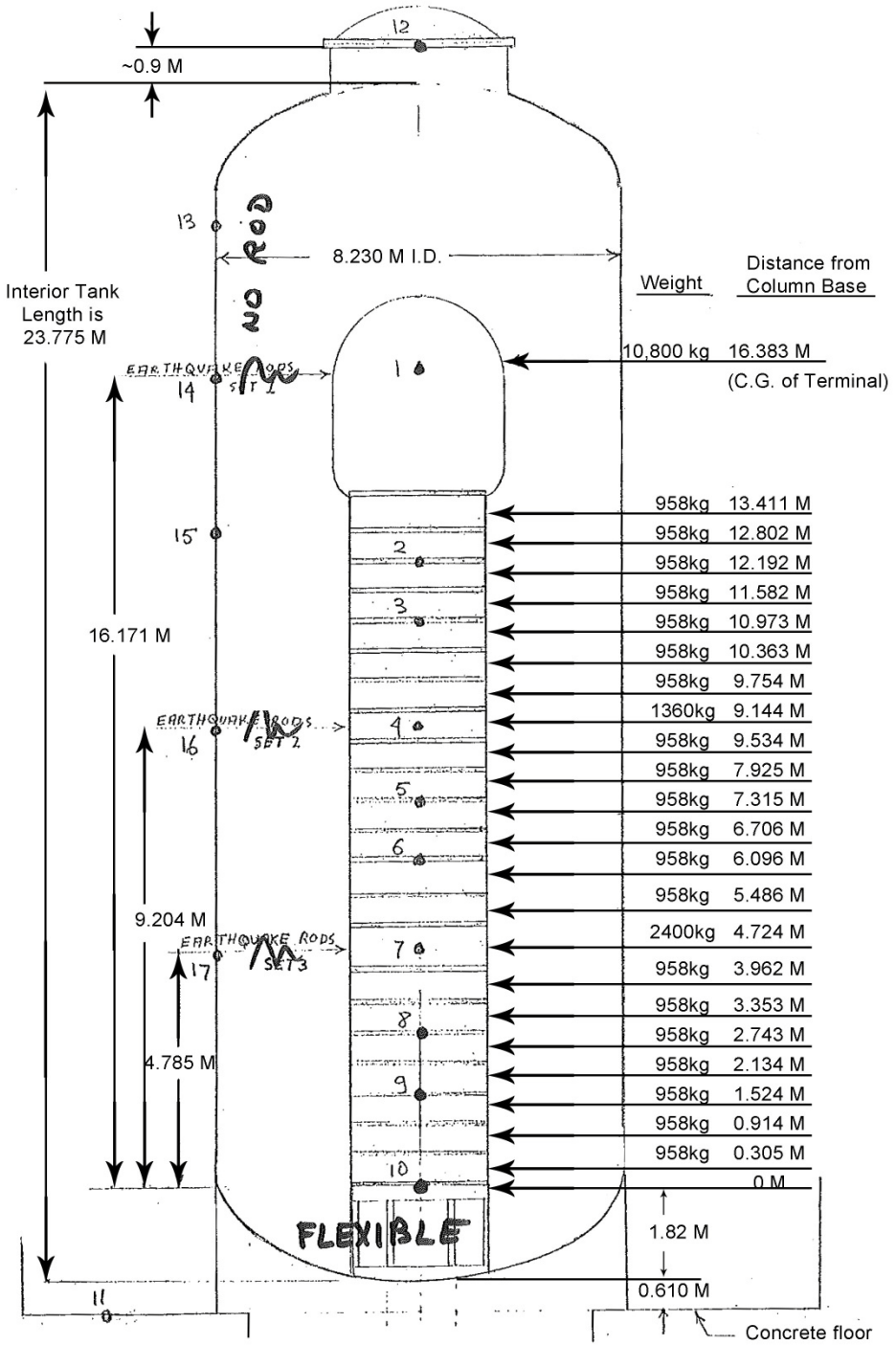
- Scientific Linux based with Xwindows
- AccelNET software (NEC)
  - All parameters monitored and controlled
  - Fully automated sample running by events, precision, or time
  - Except vacuum – monitor only
  - Save and Restore for all parameters
  - True remote operation, web interface allows factory customer support
  - Labview interface
  - Assignable knobs and analog meters
  - Multiple control consoles allowed
  - Flat topping routines
  - Bending magnets, energy and mass determined
  - Faraday Cup Sequencer (beam current save)
  - Strip chart recorder

23.8 meters high
8.2 meters diameter
574,000 lbs.
(260,360 kg)





6MV Tandem Pelletron Model 18SDH-2



Previous strongest earthquake Taft 1952 Peak acceleration of 180 gals (0.18 g)

Analysis by
Dr. A. H. Peyrot

March 11, 2011 peak acceleration was 342.9 gals (0.34 g)

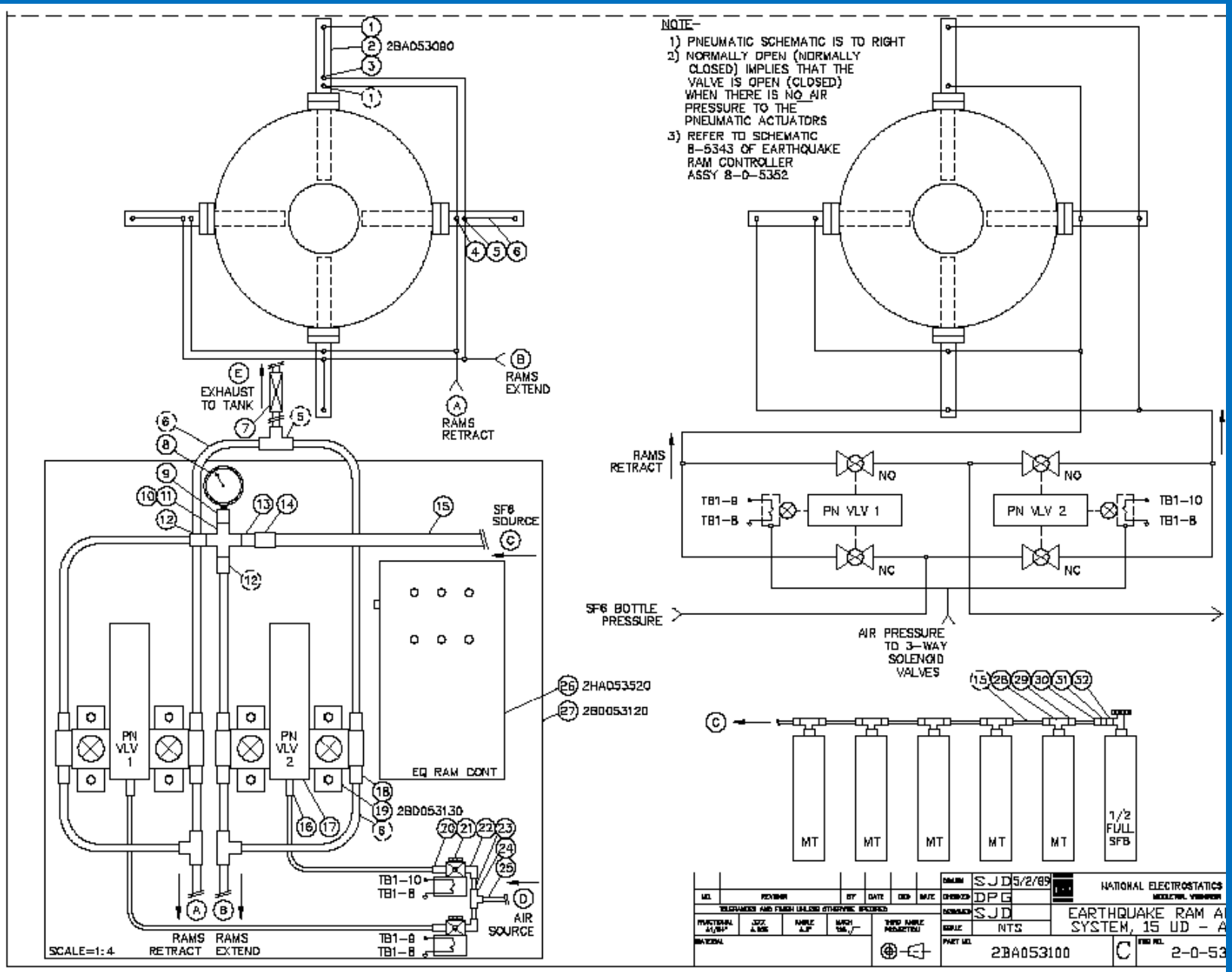
Internal Verification Process

筑波大学 University of Tsukuba
UTTAC

3月23日
Accelerator release operation

3月17日　Confirmation
Accelerator tank bottom windows

3月23日
Accelerator tank top


NOTE-
1) PNEUMATIC SCHEMATIC IS TO RIGHT
2) NORMALLY OPEN (NORMALLY CLOSED) IMPLIES THAT THE VALVE IS OPEN (CLOSED) WHEN THERE IS NO AIR PRESSURE TO THE PNEUMATIC ACTUATORS
3) REFER TO SCHEMATIC B-5343 OF EARTHQUAKE RAM CONTROLLER ASSY 8-D-5352
2BA053080
EXHAUST TO TANK
RAMS EXTEND
RAMS RETRACT
SF6 SOURCE
PN VLV 1
PN VLV 2
EQ RAM CONT
2BA053520
2BD053120
2BD053130
TB1-10
TB1-8
AIR SOURCE
SCALE=1:4
RAMS RETRACT
RAMS EXTEND
NO
NC
SF6 BOTTLE PRESSURE
AIR PRESSURE TO 3-WAY SOLENOID VALVES
MT
1/2 FULL SFB
SJD 5/2/89
DPG
SJD
NTS
NATIONAL ELECTROSTATICS
EARTHQUAKE RAM A
SYSTEM, 15 UD - A
2BA053100
C
2-0-53