

Accelerator Technical and Operational Review – ATC/ABOC Days 2007

Session 5: AD Machine and Exp. Areas – nTOF Facility

Conveners: I. Efthymiopoulos
T. Eriksson

- Highlights from the presentations
- Summary notes

Ilias Efthymiopoulos – AB/ATB-EA
ATC/ABOC Days – Summary Meeting
February 9, 2007

Session 5: AD Machine & Exp. Areas – nTOF Facility

Wednesday, 24 January 2007	
09:00	[88] Introduction to the session by Ilias EFTHYMIPOULOS (874-1-011: 09:00 - 09:05)
	[89] AD Physics in 2007 and beyond  slides by Walter OELERT (874-1-011: 09:05 - 09:25)
	[67] AD experimental areas - operation and majors problems in 2006, outlook for 2007  slides by Tommy ERIKSSON (874-1-011: 09:25 - 09:50)
10:00	[90] Discussion on AD issues (874-1-011: 09:50 - 10:10)
	[81] The physics program at n_TOF in 2007 and beyond  slides by Alberto MENGONI (874-1-011: 10:10 - 10:30)
	Coffee break (10:30 - 10:45)
	[68] RP issues for safe operation of the nTOF facility  slides by Thomas OTTO (874-1-011: 10:45 - 11:00)
11:00	[69] What needs to be done to restart nTOF  slides by Paolo CENNINI (874-1-011: 11:00 - 11:25)
	[70] New nTOF target design issues  slides by Ans PARDONS (874-1-011: 11:25 - 11:45)
	[72] Characterization of the nTOF radioactive waste  slides by Markus BRUGGER (CERN AB/ATB) (874-1-011: 11:45 - 12:00)
12:00	[82] Towards a permanent disposal of the nTOF radioactive waste  slides by Luisa ULRICI (874-1-011: 12:00 - 12:14)
	[93] Discussion (874-1-011: 12:15 - 12:30)

AD

nTOF

Many thanks to all speakers !!!!

AD Machine and Exp. Areas : the users

AD-Physics in 2006 and beyond

Walter Oelert
Research Centre Jülich, Germany
Ruhr Universität Bochum, Germany
CERN
24. January 2007



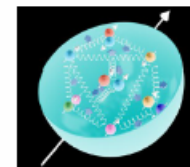
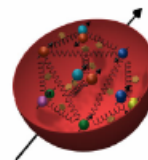
AD-1	<i>ATHENA completed</i>
AD-2	<i>(ATRAP) Cold Antihydrogen for Precise Laser Spectroscopy</i>
AD-3	<i>(ASACUSA) Atomic Spectroscopy and Collisions Using Slow Antiprotons The ASACUSA Collaboration</i>
AD-4	<i>(ACE) Relative Biological Effectiveness and Peripheral Damage of Antiproton Annihilation</i>
AD-5	<i>(ALPHA) Antihydrogen Laser Physics Apparatus</i>

new, to come:

AEGIS: a new proposal in preparation and it will be submit within 2007
The main goal is a direct gravity measurement on antihydrogen
Antiproton beam time: probably in 2009
We are planning to install the apparatus in the actual DEM zone
ELENA will be welcome and we support it.

Gemma Testera

The PAX collaboration



W. Oelert – PH/DI

AD Machine and Exp. Areas : the users

This was nearly all for:
AD-Physics in 2006 and beyond,
I should not stop without giving some thoughts to the
AD-performance during 2006 and the hopes for 2007 and beyond.

The AD-users appreciate very much the effort, work and inputs
from all people being involved in the complicated operation
of the CERN accelerator system down to the AD.

However, we do observe a substantial decrease in the reliability
of the regular performance as:
Instabilities and not optimal intensities reduce the efficiencies of the experiments,
shifts of beam time by weeks cause schedule problems of the experimentalists
coming from all over the world.

We do hope for a continuous smooth running in 2007 and beyond
with as many p-bars as possible, stable and precise.

I hope that I could convince you that the experiments make good use
of the expensive and unique p-bar beam from AD
which we will need for our physics to the benefit for all of us.

W. Oelert – PH/DI

AD Machine & Exp. Areas

2006 startup problems – prospects for 2007

- ❑ Physics on August 22nd with all beam lines – 5 weeks late.
- ❑ In addition longer rep. rate (120sec instead of 90sec in 2004) and lower intensity.
 - Investigate possibility to accommodate a 5th bunch in the cycle to increase the intensity by 25%
- ❑ Overall efficiency in AD for 2006 ~65%
 - mainly due to start-up problems - once the machine started the efficiency went back to normal 85-90% level
 - AD operation: continue running over weekends
 - ❑ 2 shifts/day during start-up ; 1 specialists on call/week ; 1 backup / week
 - Sharing of resources with LEIR in 2007 is a concern
- ❑ Longer time to restart the AD power supplies. Priority for PO was given to PSB and PS, experts left for other activities. Considerable effort from the new team which spend quite some time in AD partly because they had to learn the system.
 - Shutdown work + acquainted knowledge of the installations → hope for better service.
 - However AD may still suffer from priorities wrt to other machines

AD Machine & Exp. Areas

... 2006 startup problems – prospects for 2007

- ❑ Several control issues, in particular with OASIS
 - General issue that affects operation for other machines – hope it will be solved for the 2007 start-up.

- ❑ Delicate to adjust the e-cooler also due to lack of diagnostics in the beam line.
 - Effort should be put in 2007 to understand the problem

- ❑ Difficulties to transport the beam for the ALPHA experiment – wrong trajectory at the exit of AD ring that gave false indication in downstream MWPCs
 - New MWPC will be installed in the area to provide additional diagnostics.

- ❑ Increased beam losses in the PS-AD transfer line. Was not possible to investigate further due to lack of time
 - Schedule MD time to investigate the problem and reduce losses.

AD Machine & Exp. Areas - summary

- Consolidation remains the main issue in AD. If the machine has to run beyond 2010, a serious consolidation effort is required
 - A way should be found in the present consolidation program that “small” machines are not penalized by the risk analysis and some critical items for their operation can still be scheduled.
 - Present AD consolidation list for 2007-2010: **10FTE and 1.5MCHF** but it is beyond the budget limit line !

- Maintaining the stability and performance of the machine is a key issue
 - Effort should be put to understand the e-cooler performance and trajectory corrections
 - Effort should be put to understand the beam losses in the ejection line and invest in new monitors and correctors

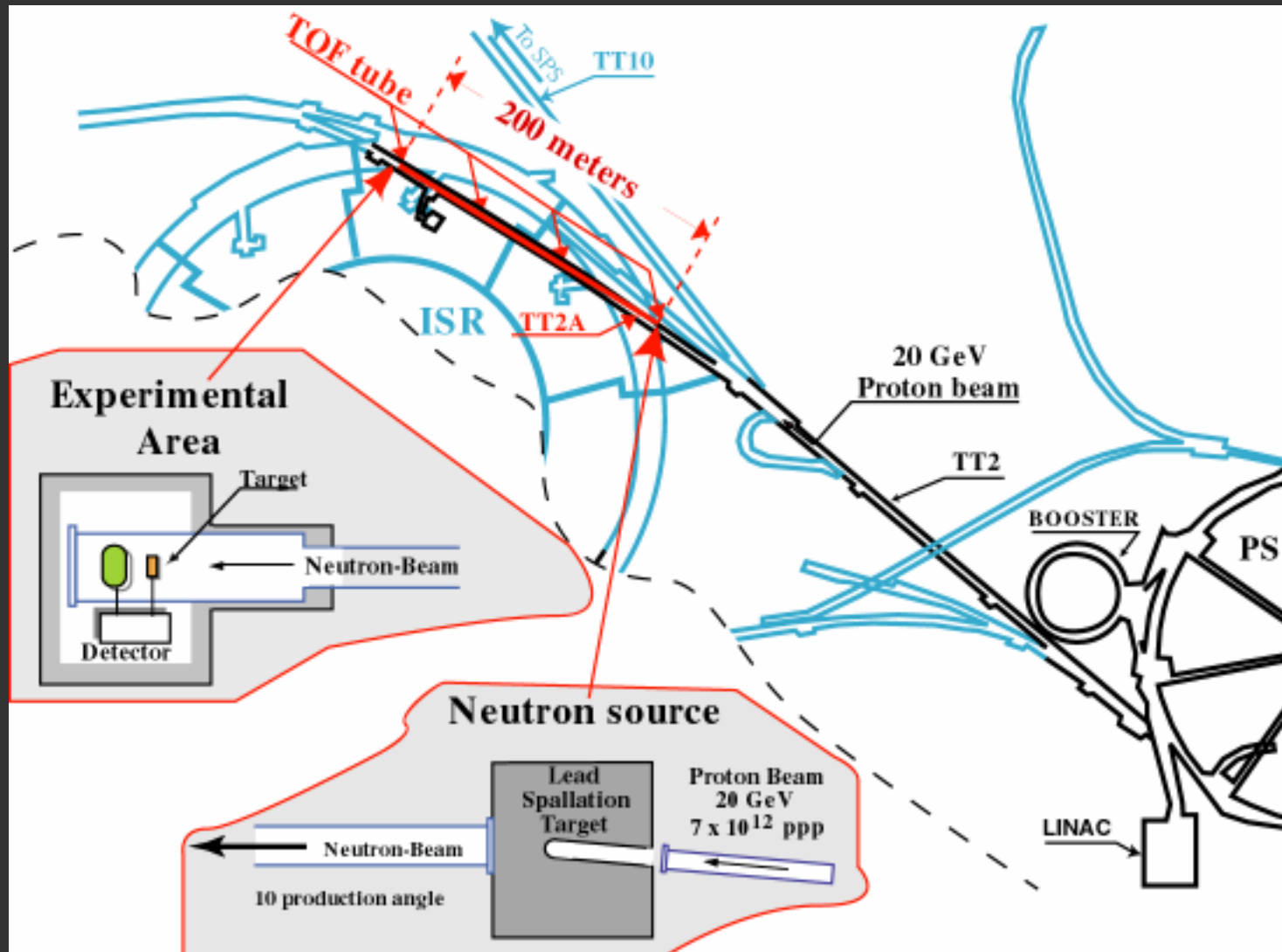
- The interest of the AD users remains - several proposals for future projects are underway with challenging physics studies

nTOF Facility

Can we restart nTOF for 2007 (August?)

- The nTOF user's point of view
- What needs to be done and why
- What it implies for budget / manpower / timescale

nTOF Facility – reminder...



nTOF Facility – the user's point of view

Capture

^{151}Sm
 $^{204,206,207,208}\text{Pb}, ^{209}\text{Bi}$
 ^{232}Th
 $^{24,25,26}\text{Mg}$
 $^{90,91,92,94,96}\text{Zr}, ^{93}\text{Zr}$
 ^{139}La
 $^{186,187,188}\text{Os}$
 $^{233,234}\text{U}$
 $^{237}\text{Np}, ^{240}\text{Pu}, ^{243}\text{Am}$

Fission

$^{233,234,235,236,238}\text{U}$
 ^{232}Th
 ^{209}Bi
 ^{237}Np
 $^{241,243}\text{Am}, ^{245}\text{Cm}$

n_TOF experiments 2002-4

28 weeks/yr (average)
483 effective 8hr-shft/yr
1.3e19 protons/yr

Problems during Phase-1 runs:
2nd collimator alignment (minor)
beam-requests (minor)
end of 2004 run increased activity in the cooling (major, to be discussed later)

The n_TOF Collaboration

A. Mengoni - nTOF

nTOF Facility – the user's point of view

n_TOF: resume activities in 2007

All teams involved in Phase-1 expressed interest to continue the activities for n_TOF Phase-2

- Lol, January 2005
- Budget for M&O allocated by funding agencies
- new MoU, draft ready December 2006

2.5 years after last neutron beam delivered to EAR-1

New PhD students need data to work on(*)

EC I3 projects in FP6 (EFNUDAT, EUROTRANS) running

(*) so far: 13 PhD Thesis (completed), 6 in preparation (4 to be completed by 2007), 2 starting in 2007

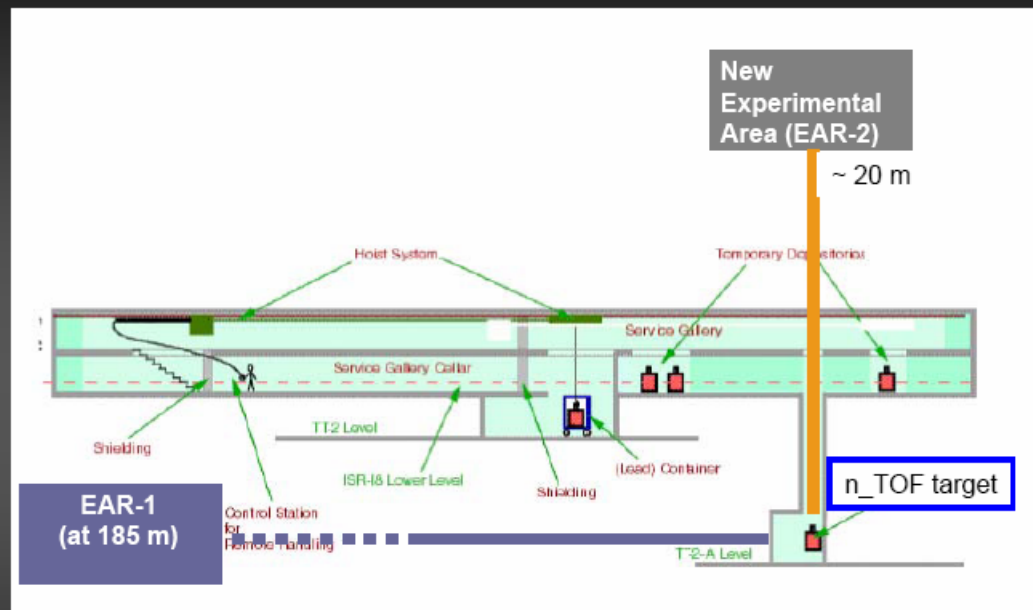
www.cern.ch/n_TOF

The n_TOF Collaboration

A. Mengoni - nTOF

nTOF Facility – the user's point of view

The second n_TOF beam line & EAR-2



Flight-path length : ~20 m
at 90° respect to p-beam direction
expected neutron flux enhancement: ~ 100
drastic reduction of the t_0 flash

n_TOF-Ph2

A. Mengoni - nTOF

nTOF Facility – what needs to be done

New n-TOF target

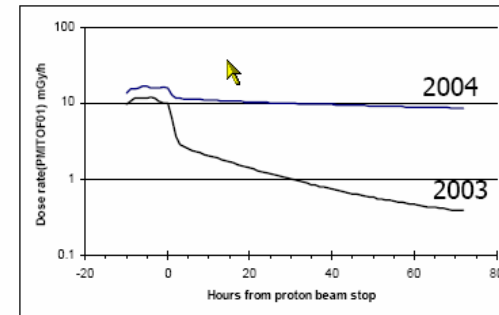
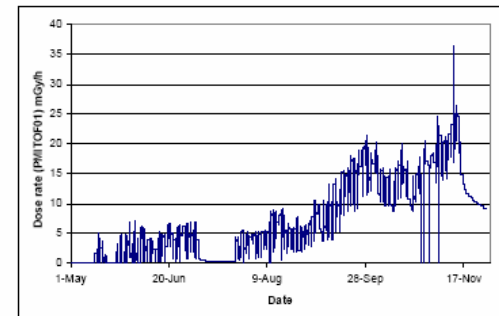
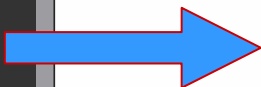


- N-TOF cooling water circuit contaminated by spallation products from lead target
- Action:
 - Remove present target, clean circuit as far as required (specific activity remaining must be lower than release limits)
 - New cladded spallation target is required, under study in AB-ATB (presentation Ans Pardons)

1



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Build-up and decay of water contamination

ATC and ABOC Days 2007
Thomas Otto, SC-RP, CERN

3

T. Otto – SC/RP

nTOF Facility – what needs to be done

Ventilation in target area



- N-TOF target dimension approx. one interaction length, no dump
- Intense hadronic cascade leaving target
- Consequence: Air activation
- TT2a was a transfer tunnel, not a target area
- **Ventilation must be refitted.**
- Study in AB-ATB, TS-CV and SC-IE:
 - Minimize dose to critical group of public
 - Recirculation during operation
 - Monitored release before access to TT2a
 - Presentation P. Cennini

Isotope	Activity concentration	
	Door 203	Door 204
	Bq m ⁻³	Bq m ⁻³
⁷ Be	860	27
²⁴ Na	290	4

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Thomas Otto, SC-RP, CERN

4

3

T. Otto – SC/RP


nTOF Facility – what it implies: target removal



nTOF target

- $80 \times 80 \times 60 \text{ cm}^2$, 4.0T pure Pb
- Water cooled – Al tank (140 lt)

nTOF Facility – what it implies: target removal



Old Target Removal: What need to be done

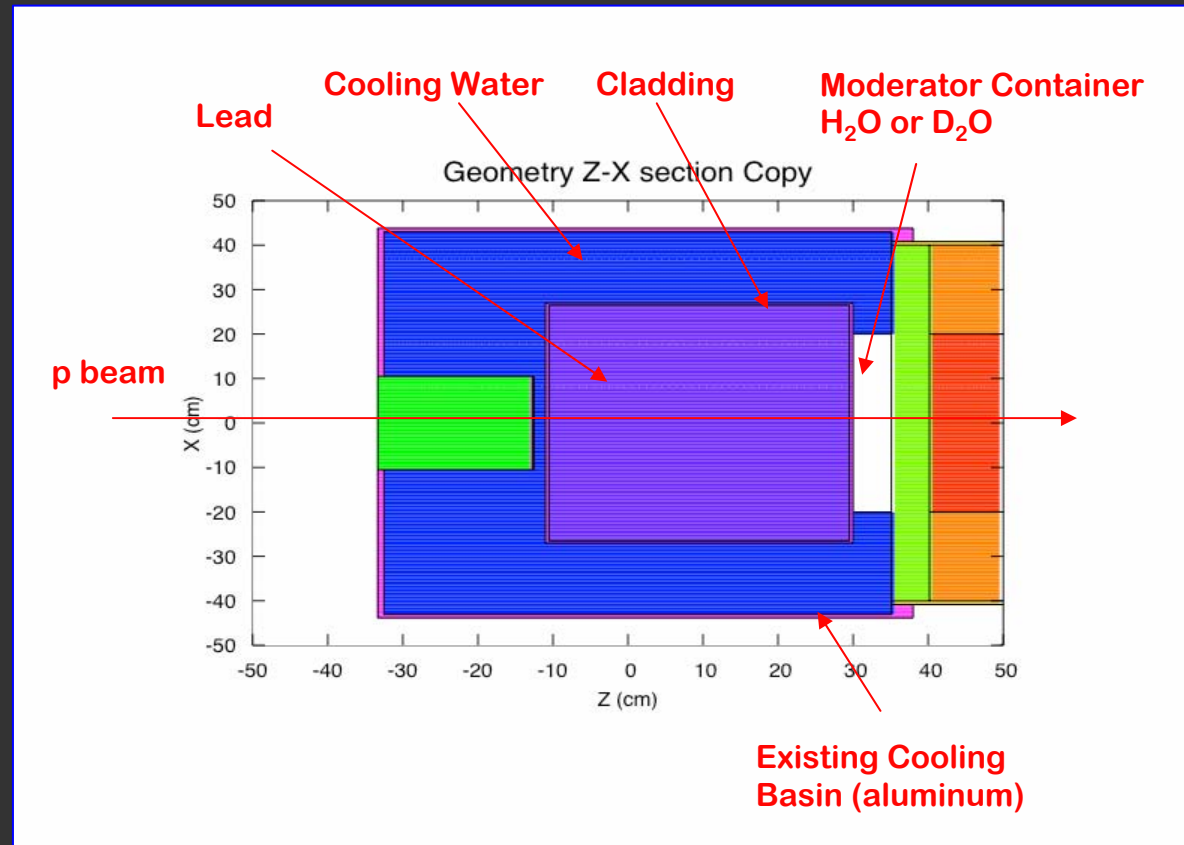
- **Problem: reliability of the Hoist System**
The probability of failure of the existing system is considered too high.
- **Solutions:**
 - **Installation of a new Crane with improved reliability**
This solution has been already investigated. An offer in the framework of the “Contrat de maintenance Equipement de Levage et de Transport” is available.
(Cost 320 kCHF, delivery time 19 weeks)
 - **Modification of the existing Crane**
The feasibility of a solution requiring a mechanical design validated by SC-GS in the framework of **Code D1-7.2**, has been investigated (**EDMS 787079**).

• **Independently on the adopted solution, the infrastructure and the procedure for the Target recovering in case of stacking of the Hoist System must be provided.**
(According with informal discussions with SC-GS)

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nTOF Facility – what it implies: new target design

- ❑ Baseline option: keep the existing cooling circuit and tank
- ❑ Optimized design
 - smaller mass (1T), cylindrical shape, optimized support structure for positioning within the cooling tank
- ❑ Cladding



nTOF Facility – what it implies: new target design

□ Challenges to phase

- handle the different expansion between cladding and core resulting to large forces on shell
- increase local velocity of the cooling water to optimise the cooling power
- optimize target design for elasto-plastic behaviour due to shockwaves and cyclic stresses from the beam impact.
- integration issues for the support and guiding system allowing precise positioning remotely.

□ It is very likely that the same fatigue effects were present in the old target, which could explain the observed increased radiation levels in the cooling circuit.

□ A visual inspection of the old target would provide useful input in understanding these issues and guide the new design.

nTOF Facility – what it implies: new target design

Estimated Cost, Manpower & Time

- **Cost target & supports:**
240 kCHF
- **Manpower**
AB/ATB: 1.5 FTE - SC/RP: 0.5 FTE - TS/MME: ?
- **Time for design (internal)**
4 – 6 months
- **Time for target production (external)**
6 – 9 months

Ans PARDONS

ABOC Days 22-24/01/2007

Slide 14 of 14

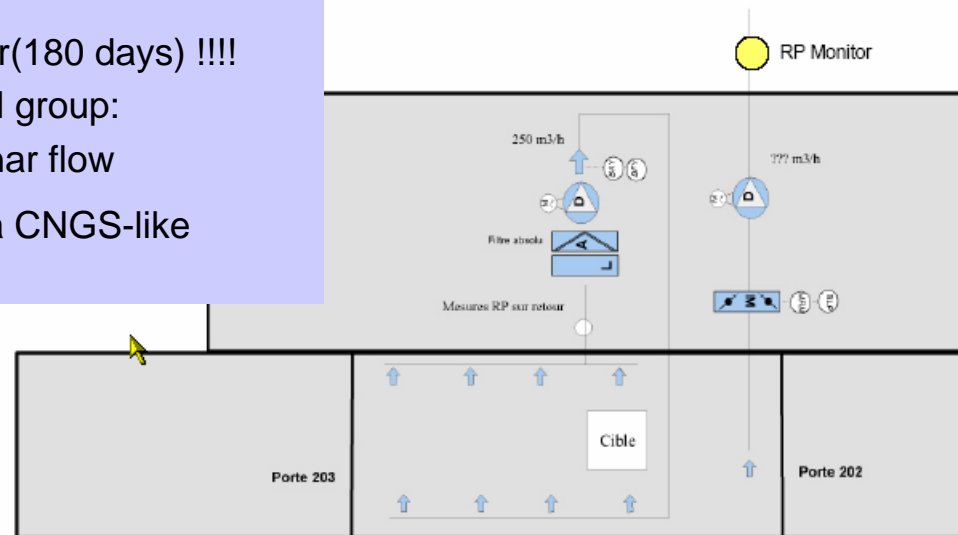
A. Pardons – AB/ATB

nTOF Facility – what it implies : ventilation

Ventilation of the Target Area: Layout for the minimum Release Scenario

FLUKA Simulations:

- ❑ assuming 3.2×10^{19} pot/year(180 days) !!!!
- ❑ dose estimate in the critical group:
 - ❑ $1 \mu\text{Sv}$ assuming laminar flow
 - ❑ $0.01 \mu\text{Sv}$ per flush if a CNGS-like system is installed.



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Budget estimate:

- ❑ 200 KCHF for the complete system
- ❑ Resources in TS/SC, TS/CE, SC/RP

nTOF Facility – radioactive waste disposal

Introduction FLUKA Sim. Waste Study New Target

Nuclide Vector

- **First estimate for detailed composition (NAGRA)**
- **Simplified geometry**, high statistical uncertainties
- **Low-alpha content**
 - **~2 Bq/g** specific alpha activity (<10kBq/g)
 - **~1 MBq** total activity
- **To be confirmed by detailed FLUKA calculations**

Isotope	a [Bq/g]	A [Bq]
²⁰⁵ Po	2.21E-20	9.64E-15
²⁰⁸ Po	6.98E-01	3.04E+05
²¹⁰ Po	5.68E-01	2.48E+05
²¹¹ Po	4.24E-08	1.85E-02
²¹² Po	9.34E-02	4.07E+04
²¹³ Po	1.19E-04	5.18E+01
²¹⁴ Po	9.43E-05	4.11E+01
²¹⁵ Po	1.52E-05	6.60E+00
²¹⁶ Po	1.45E-01	6.34E+04
²¹⁸ Po	9.43E-05	4.11E+01
²¹⁸ At	3.48E-11	1.52E-05
²¹⁷ At	1.22E-04	5.30E+01
²¹⁸ At	1.89E-08	8.26E-03
²¹⁹ At	1.30E-11	5.64E-06
²¹⁷ Rn	1.33E-07	5.80E-02
²¹⁸ Rn	1.89E-11	8.26E-06
²¹⁹ Rn	1.52E-05	6.60E+00
²²⁰ Rn	1.45E-01	6.34E+04
²²² Rn	9.43E-05	4.11E+01
²²¹ Fr	1.22E-04	5.30E+01
²²⁴ Fr	2.16E-07	9.41E-02
²²¹ Ra	1.22E-07	5.30E-02
²²³ Ra	1.52E-05	6.60E+00
²²⁴ Ra	1.45E-01	6.34E+04
²²⁶ Ra	9.43E-05	4.11E+01
²²⁶ Ac	1.22E-04	5.30E+01
²²⁷ Ac	1.57E-05	6.84E+00
²²⁸ Ac	1.55E-08	6.76E-03
²²⁷ Th	1.52E-05	6.60E+00
²²⁸ Th	1.44E-01	6.30E+04
²²⁹ Th	1.22E-04	5.30E+01
²³⁰ Th	4.71E-05	2.05E+01
²³² Th	4.08E-03	1.78E+03
²³⁴ Th	1.53E-07	6.68E-02
²³¹ Pa	1.56E-04	6.80E+01
²³⁴ Pa	1.99E-10	8.68E-05
²³¹ U	1.11E-45	4.84E-40
²³⁵ U	5.29E-04	2.30E+02
²³⁴ U	3.64E-06	1.59E+00
²³⁶ U	1.11E-03	2.41E+02
²³⁸ U	9.34E-08	4.07E-02
²³⁹ U	1.24E-02	5.42E+03
²³⁹ Pu	3.08E-03	1.34E+03
sum	1.96E+00	8.55E+05

24.01.2007

Characterization of the nTOF Radioactive Waste

13

M. Brugger – AB/ATB

nTOF Facility – radioactive waste disposal



TRANSPORT REQUIREMENTS

- Type A – exclusive use
- UN 2915 if the dose rate is:
 - <2 mSv/h at contact of the waste container and external surface of the transport type A container
 - <100 μ Sv/h at 1m distance of the waste container
 - <100 μ Sv/h at 2m distance of the transport container
- If the above conditions are not satisfied : special arrangement UN 2919 (not recommended)
- ➔ Shielding is needed to bring the dose rate down to 2mSv/h at the external surface of the waste container
- Contamination: waste container needed (to be decided with PSI)

Target disposal

- ❑ It is agreed that the nTOF waste will be disposed in Switzerland according to the Swiss RP legislation.
- ❑ NAGRA + PSI accepted to receive the old nTOF target for temporary storage
- ❑ PSI would like to visit CERN to become familiar with the nTOF installation and the radioactive waste

Luisa Ulrici, SC/RP

January 24, 2007

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L. Ulrici – SC/RP

nTOF Facility - summary

- ❑ It seems unlikely that the new target can be constructed on time for the nTOF running in 2007.
- ❑ The CERN management and the nTOF collaboration should be informed on the difficulties in making the target for the 2007 run.
- ❑ Provided the requested funding and resources is approved, the project could be launched aiming to produce the new target within 15 months
 - would be just on time for the 2008 start-up if no additional delays are introduced

In the meantime...

nTOF Facility - summary

- An initial budget in 2007 should be allocated in order to:
 - remove the existing target and place it in the available temporary storage
 - start preparing and possibly do its transfer to PSI
 - do a thorough inspection of the cooling basin and circuit to decide if they can be re-used or should be modified as well
 - continue the preliminary studies and identify the critical issues for the new target design