

TIK 8.1 EDD Tungsten Release Factors

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www.europeanspallationsource.se

December 17, 2015

Outline



- Highlights
- Schedule performance
- Near-term plans
- Risks and issues
- Concluding remarks

Highlights



- *The project agreement has been signed on 18th Nov. 2015*
- *The modified tubes and bubbler have been received.*
- *The full combustion system including furnace and all parts needed for experiment have been set up and tested.*
- *Variation of the temperature in the furnace/tube has been measured and calibrated.*

Agreement



Supply- and Services Agreement for non-in kind research institutions etc.

Concerning services for measuring the release of nuclides from irradiated tungsten

between
European Spallation Source ERIC
and
Danmarks Tekniske Universitet

proceedings shall be English.

16.4 The Parties undertake and agree that arbitral proceedings pursuant to this Agreement shall be kept strictly confidential, and all information disclosed in the course of such proceedings, as well as the contents of any decision or award made, shall constitute Confidential Information

IN WITNESS WHEREOF, the Agreement has been executed in two (2) originals, of which the Parties have received one (1) each.

European Spallation Source ERIC

12 Nov 2015
Date

[Signature]
Signature

Richard GAROBY
Name (in block letters)

Technical Director
Position

Danmarks Tekniske Universitet

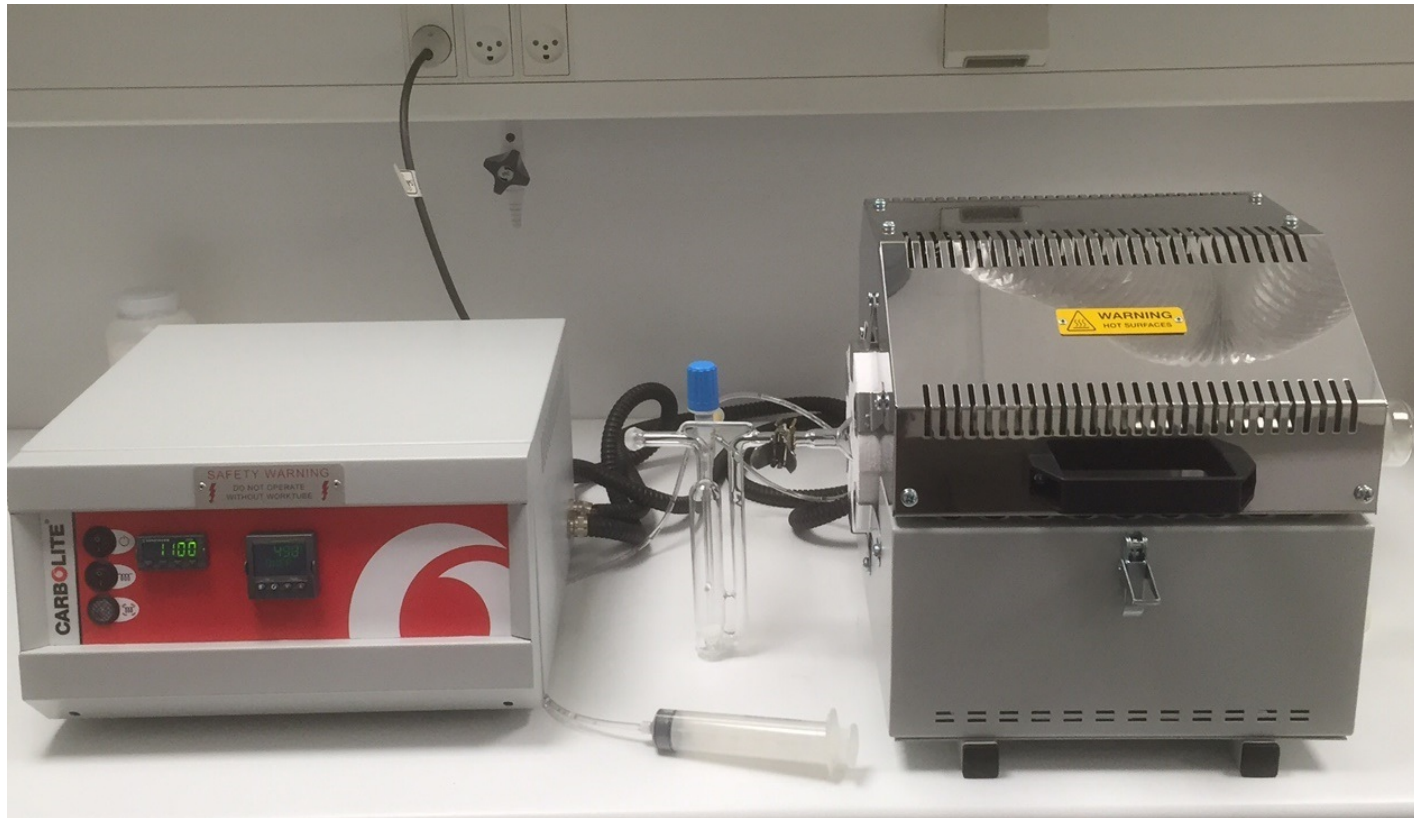
22 October 2015
Date

[Signature]
Signature

Jens-Peter Lynov
Name (in block letters)

Director, DTU Mutech
Position

Experimental setup for measurement of the release factors of iodine and bromine in tungsten target



Temperatures, °C:
2 h of each point
200,
250
300,
350,
400,
450,
500,
550,
600,
650,
700,
750,
800,
900
1000

Furnace received for experiment on releases factor of radioactive hologen from irradiated tungsten



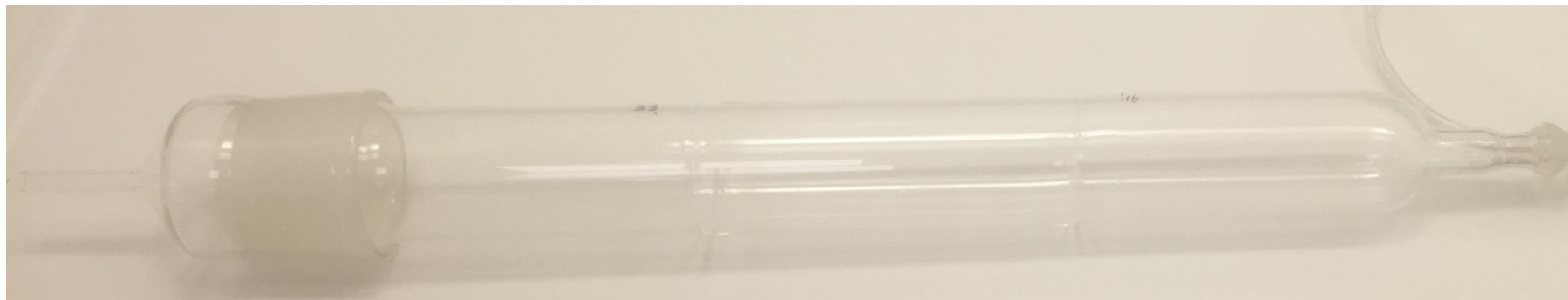
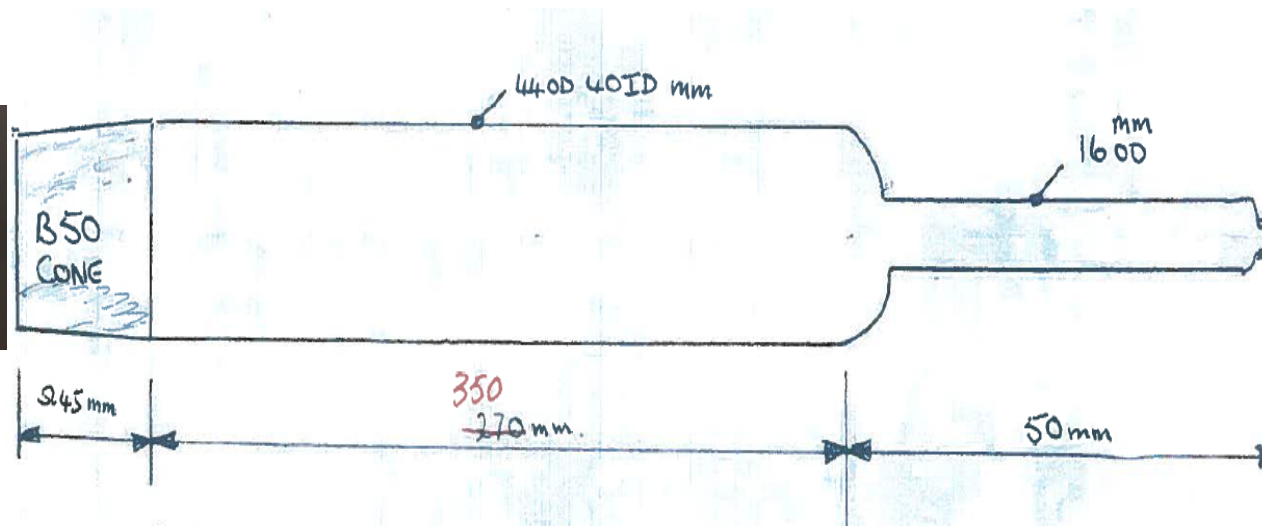
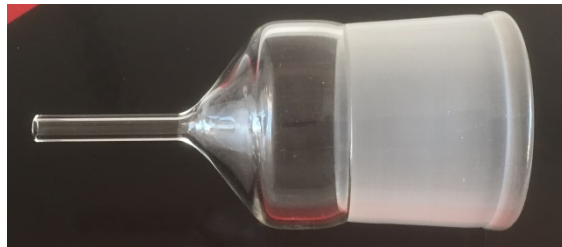
HST 12/--/200/3216P1

- Maximum operating temperature : 1200°C
- For use with a tube with 50mm OD
- Heated length : 200mm
- Uniform length @ $\pm 5^{\circ}\text{C}$: 100mm
- Eurotherm 8-segment pair programmer

Work tube

2015

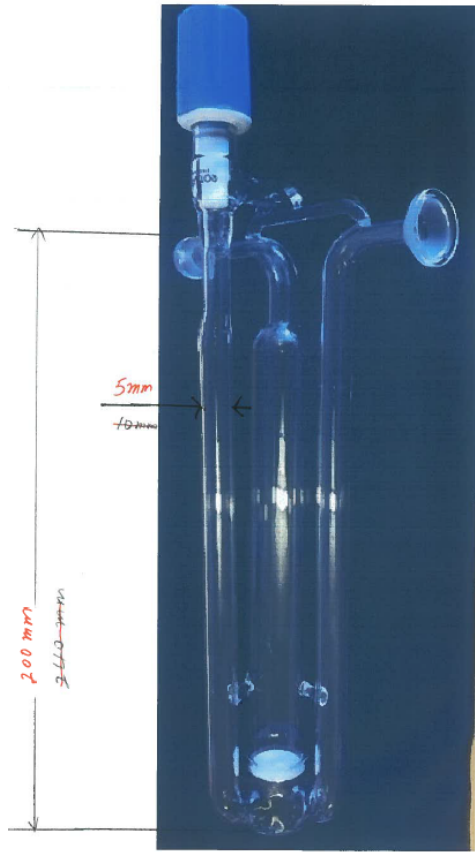
Has been modified to match the size of the furnace



Bubbler

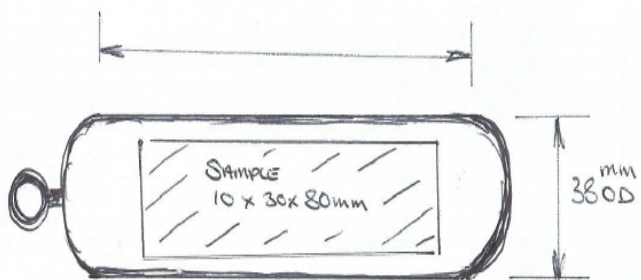
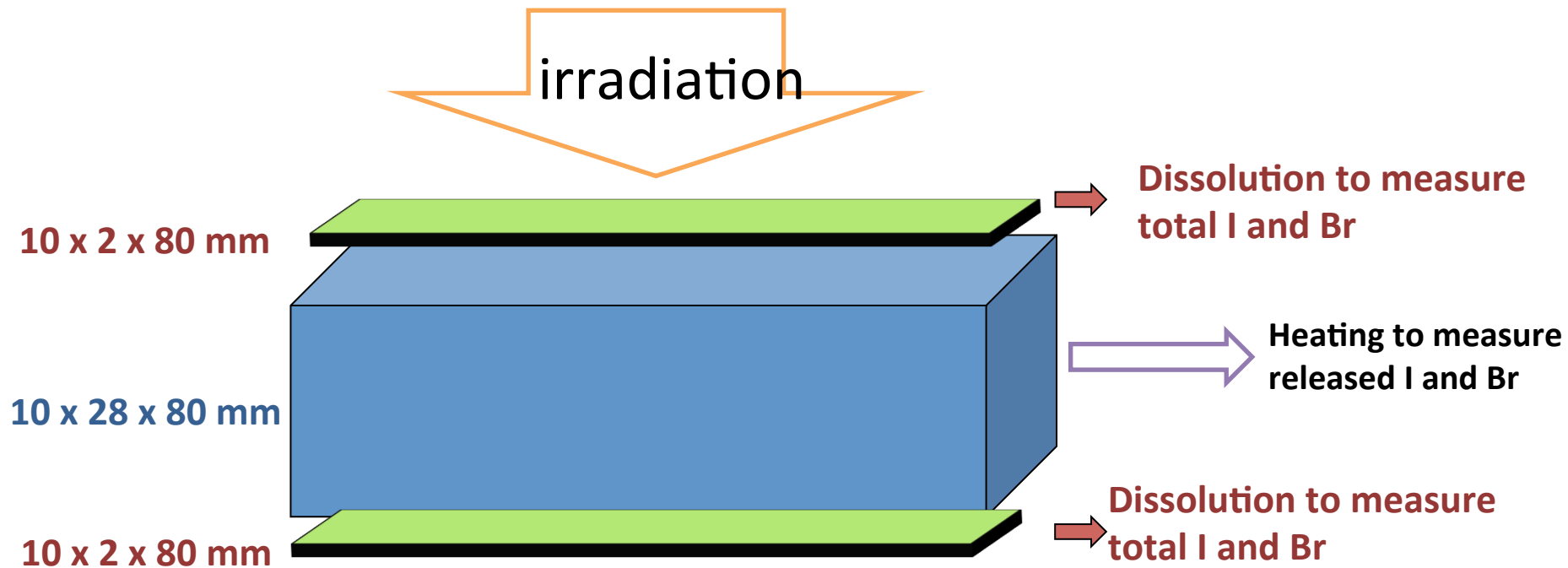
Can take and fill solution from outside of hot cell

Has been modified to match the combustion system

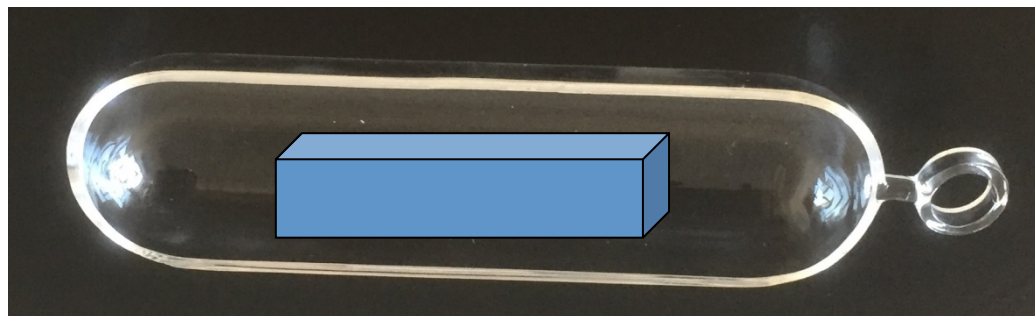


Previous designed

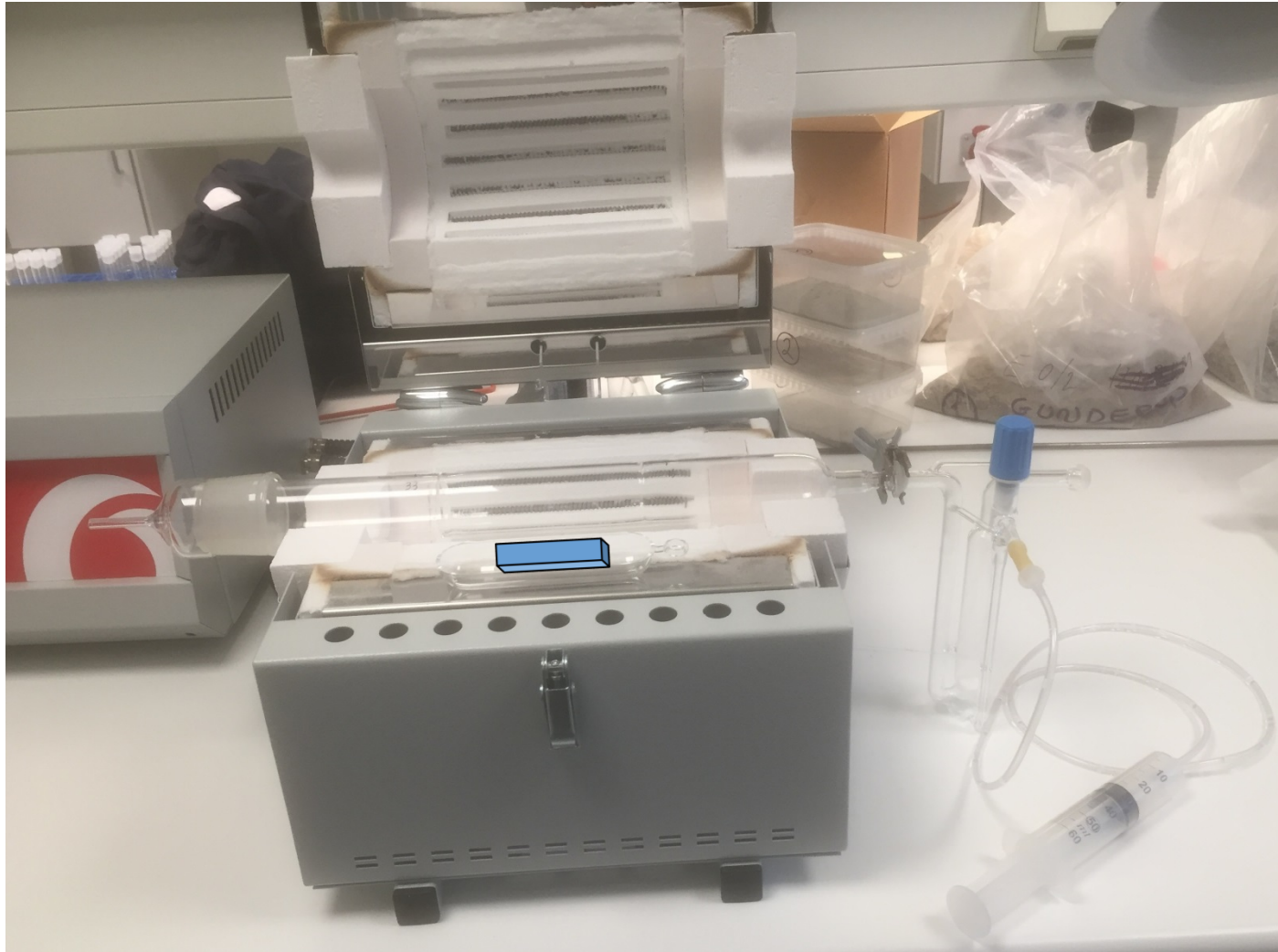




QUARTZ SAMPLE BOAT
TO FIT INSIDE THE ABOVE TUBE

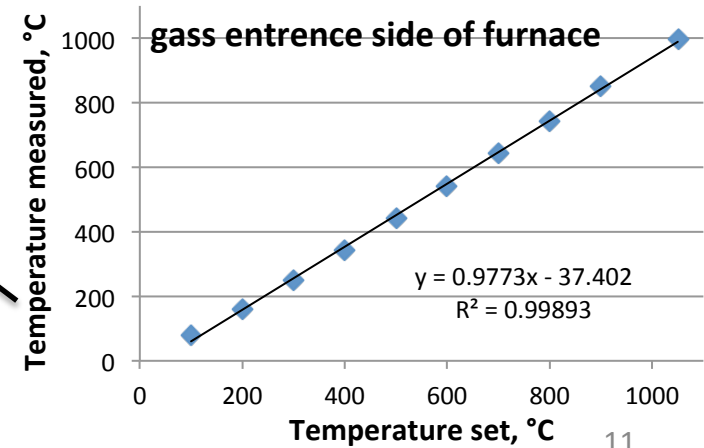
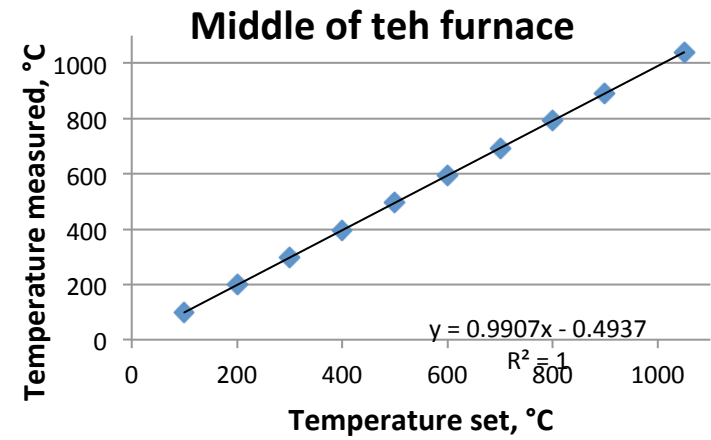
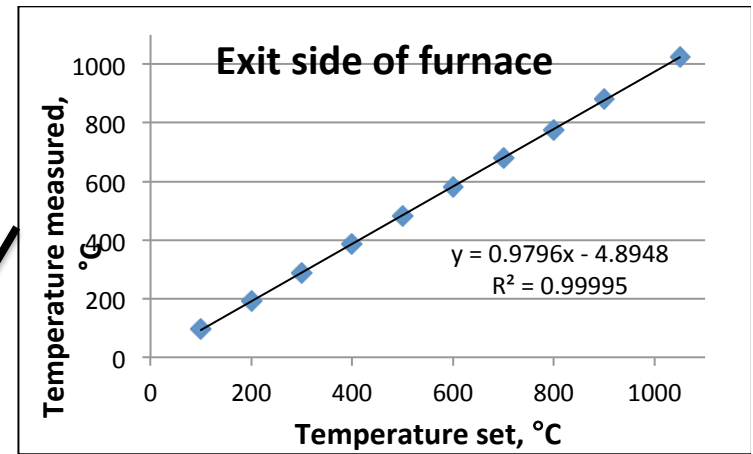
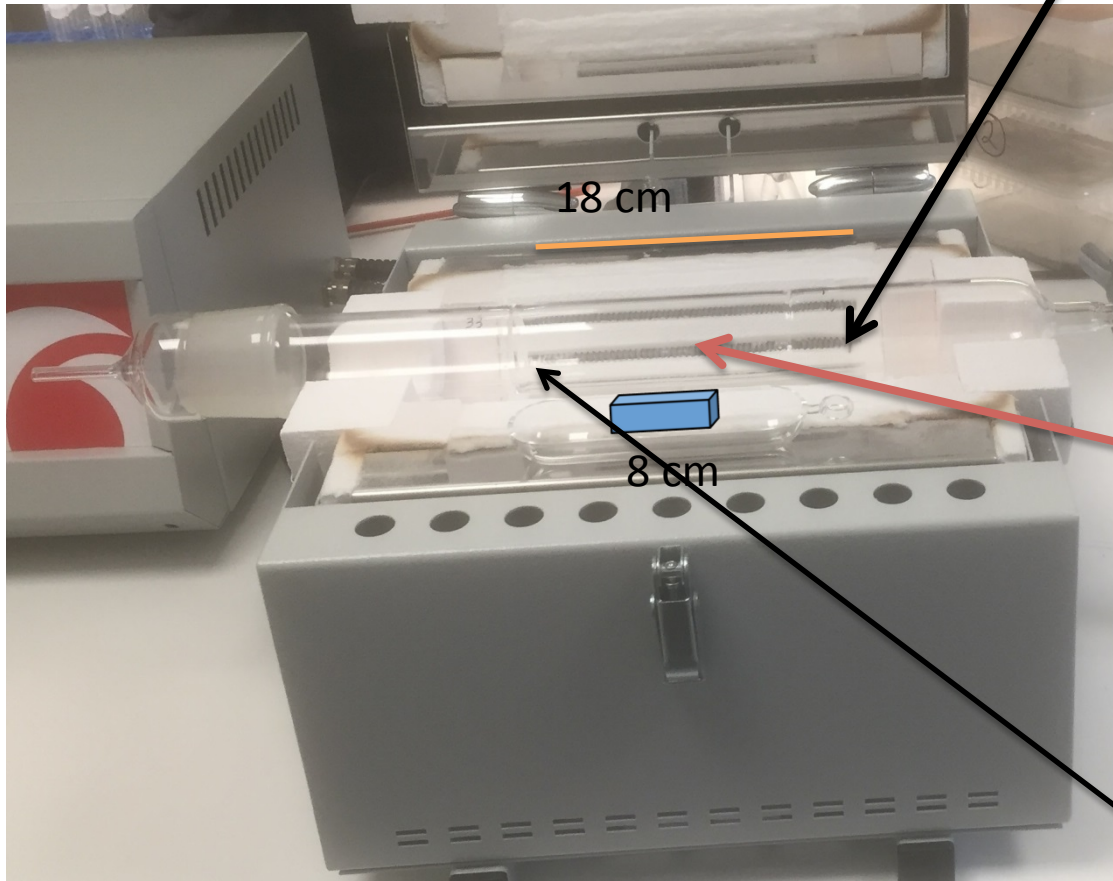


Experiment setup for release factor of radioiodine and bromine at different temperature at He gas circumstance

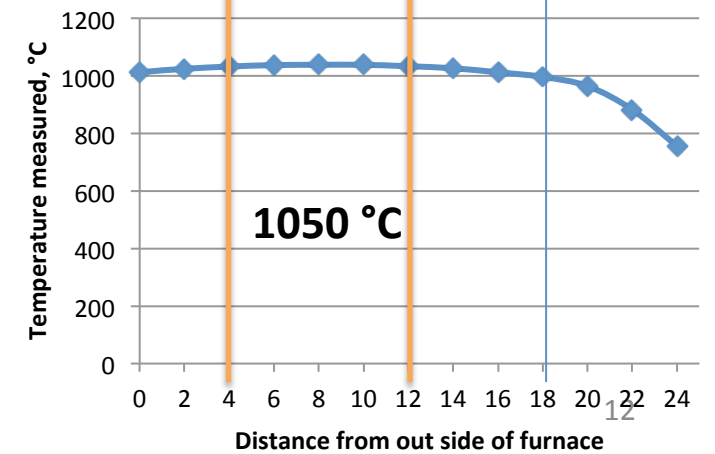
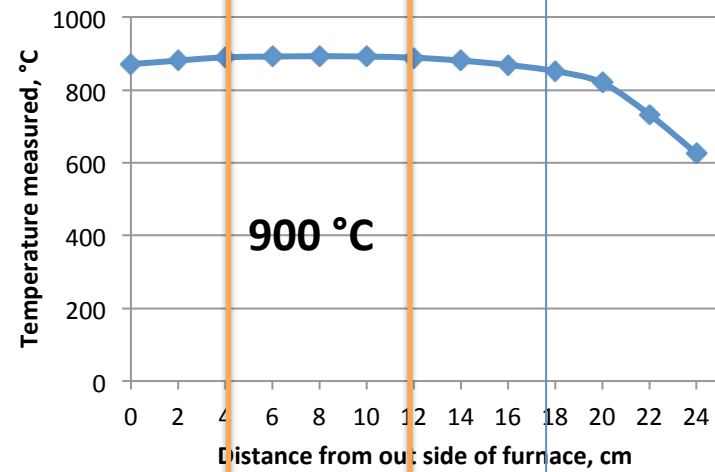
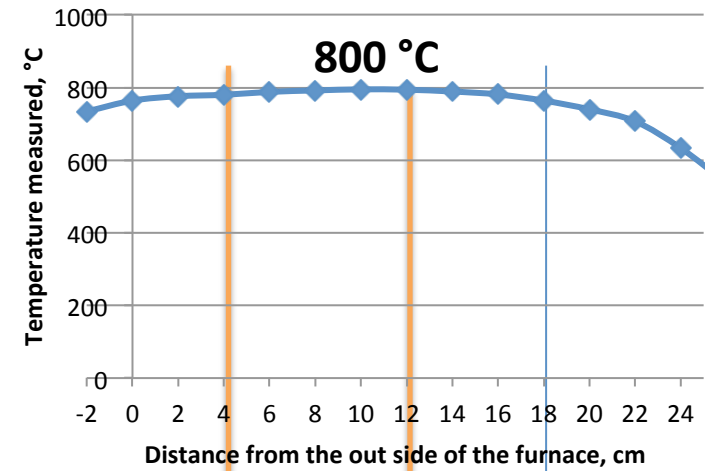
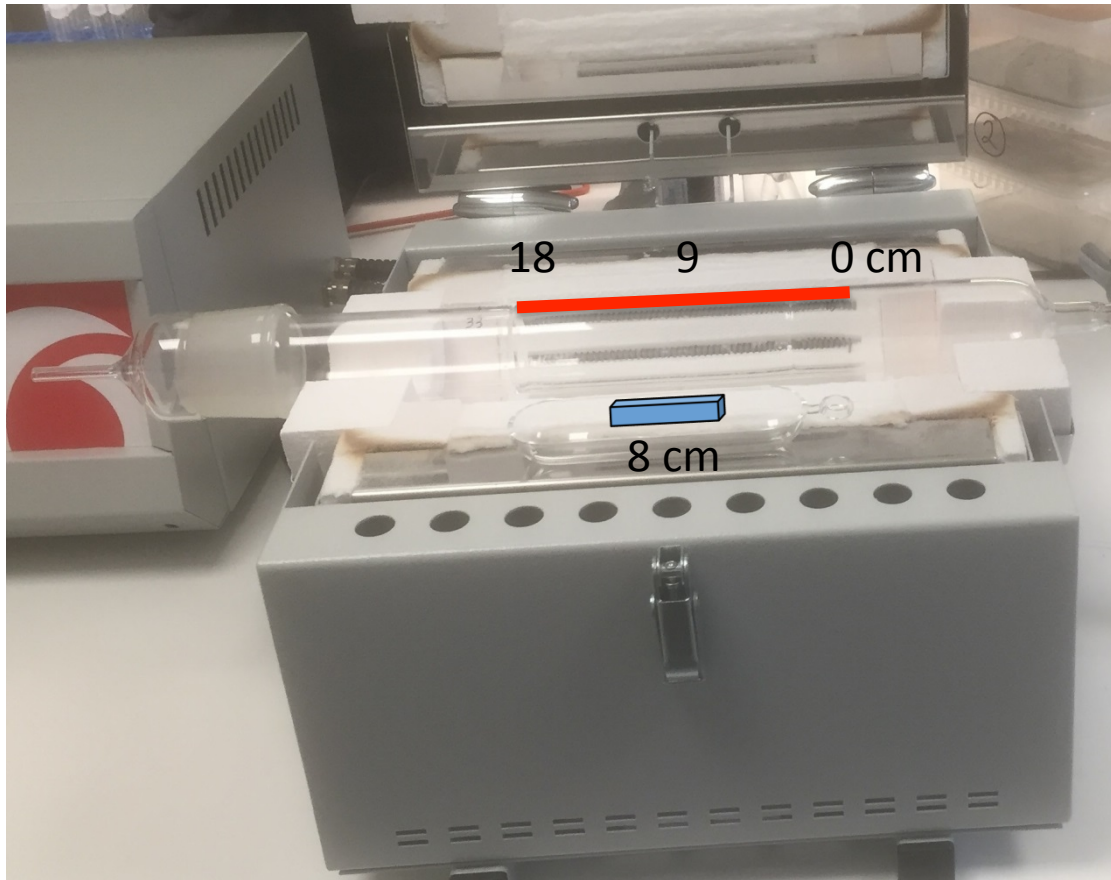


Temperature
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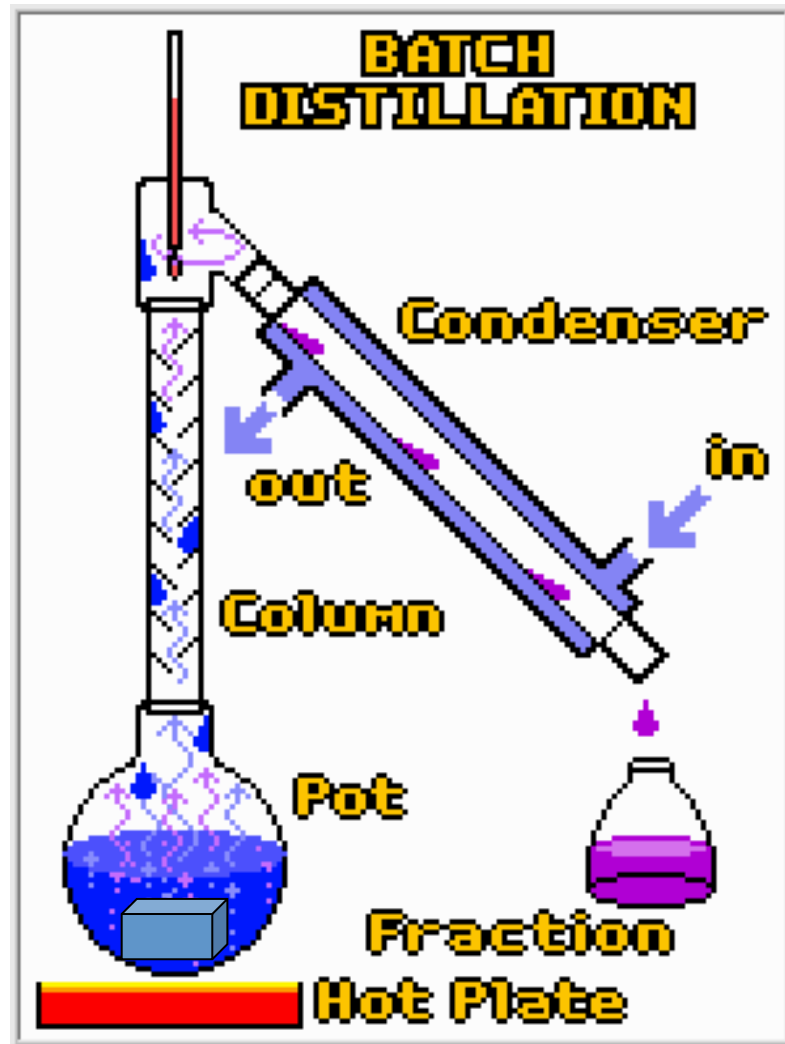
Temperature variation in the heating region in the worktube



Temperature variation in the heating region in the worktube

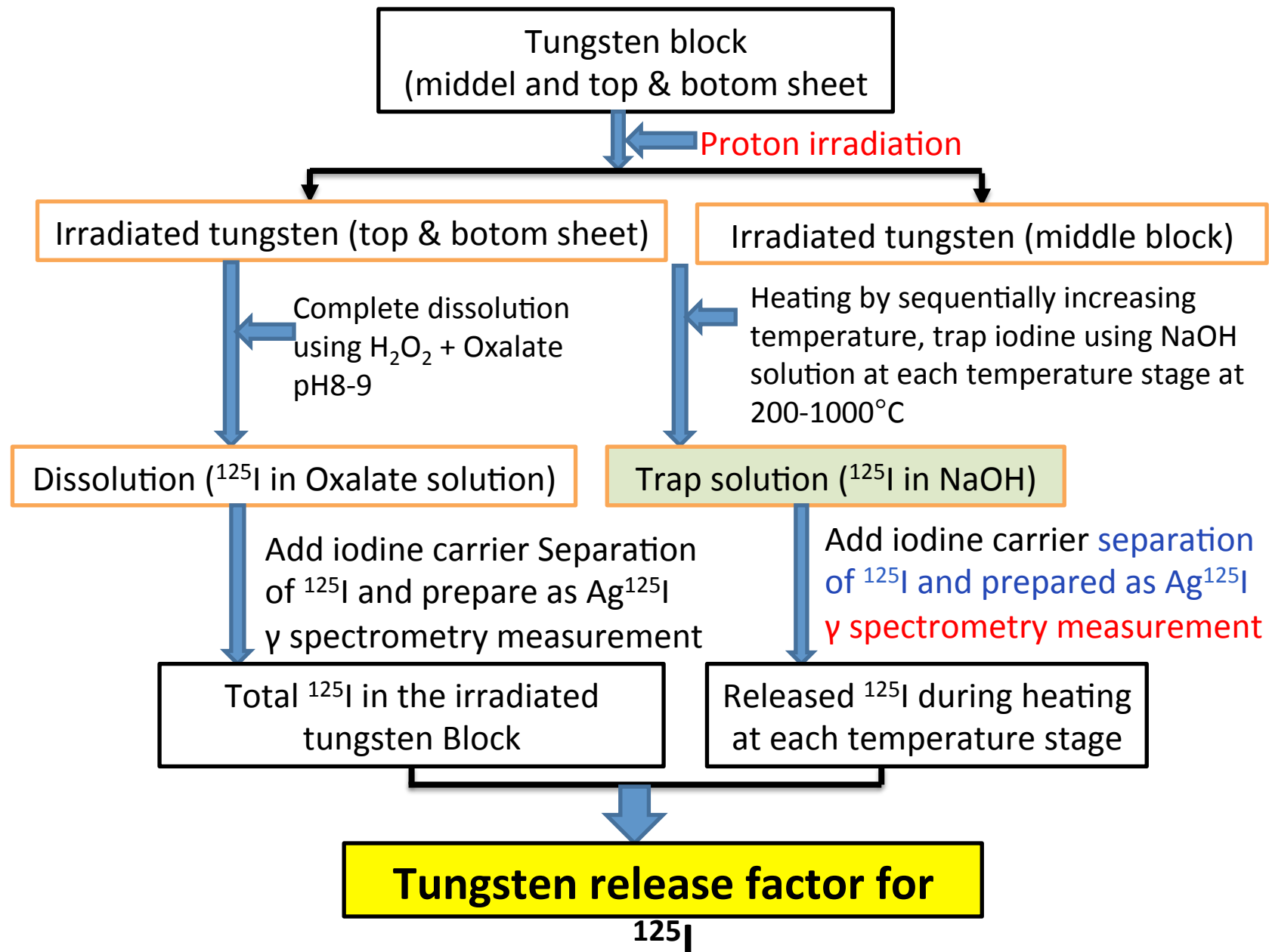


Setup of dissolution system for measurement of total I and Br in the irradiated tungsten

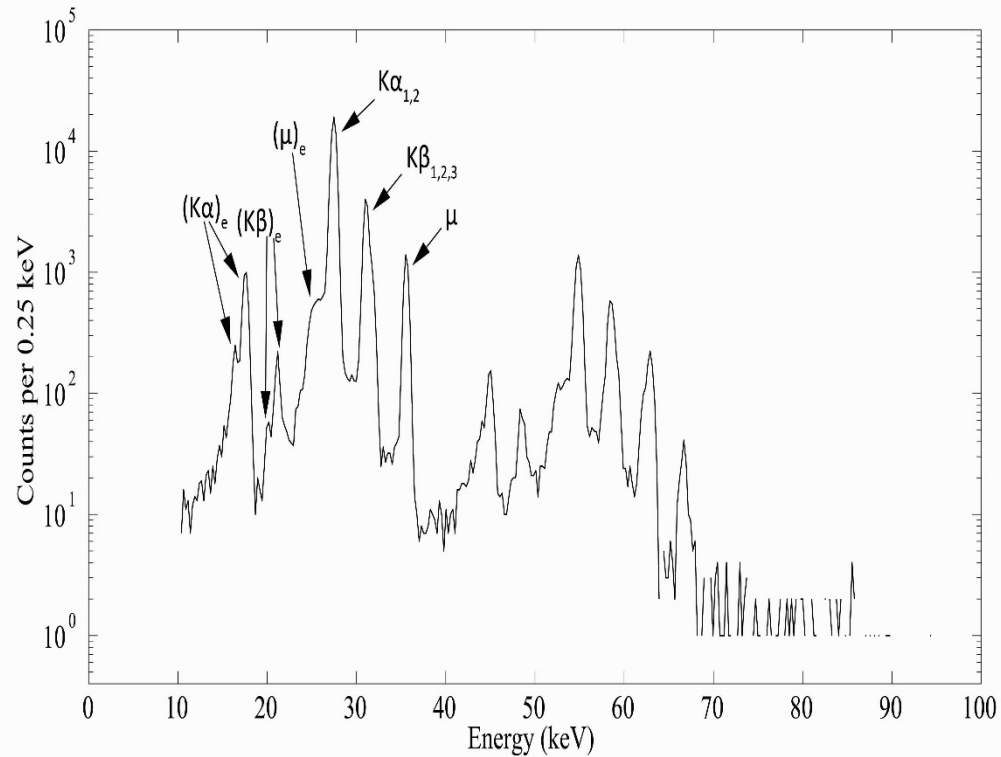


- Solution:
 H_2O_2 30% + Oxalate + NaOH (pH8-9)
- Temperature : 50-70°C
- Speed: 0.40 g/h
- Iodine loss. >5% in 3h

Overall procedure for measurement of target release factor of ^{125}I



Measurement of ^{125}I using low-energy gamma spectrometry



Counting efficiency for ^{125}I using all its γ and X-rays: **58%**

- A gamma spectrometry consisting of a U-type integral semi-planar low energy HPGe detector
- The detector has Cu end cap with a 0.5 mm carbon-epoxy window and 5 mm crystal to window distance, enable to measure low energy gamma and X-rays.

Schedule Performance (1 of 2)



- *Experiment setup has completed.*
- *Temperature test and calibration has completed*
- *Experimental plan has been prepared and to be approved*

Schedule Performance (2 of 2)



ID	Name	Planned Date	Current Forecast or Actual	Delay (W.Days)
A82550	Partner begins work (contract signed)	2015-05-01	2015-10-15	-167
A20141220	Experiment Plan Approved	2015-08-15	2015-10-26	-72
A82540	Experiment Complete	2016-10-30	2017-03-17	-138
A82560	Final Report Submitted	2016-11-30	2017-05-17	-168
AXXXXX	Site Acceptance Review	2016-12-20	2017-06-17	-179

Near Term Plans (next 3 months)



- *“Cold” experiment using spiked 131I on tungsten block is carried out.*
- *Confirmation of the minimum detectable level and uncertainty.*
- *Experiment is set up in the hot cell*
- *Test of performance in the hot cell*
- *First hot experiment using irradiated tungsten*

Irradiation of Tungsten



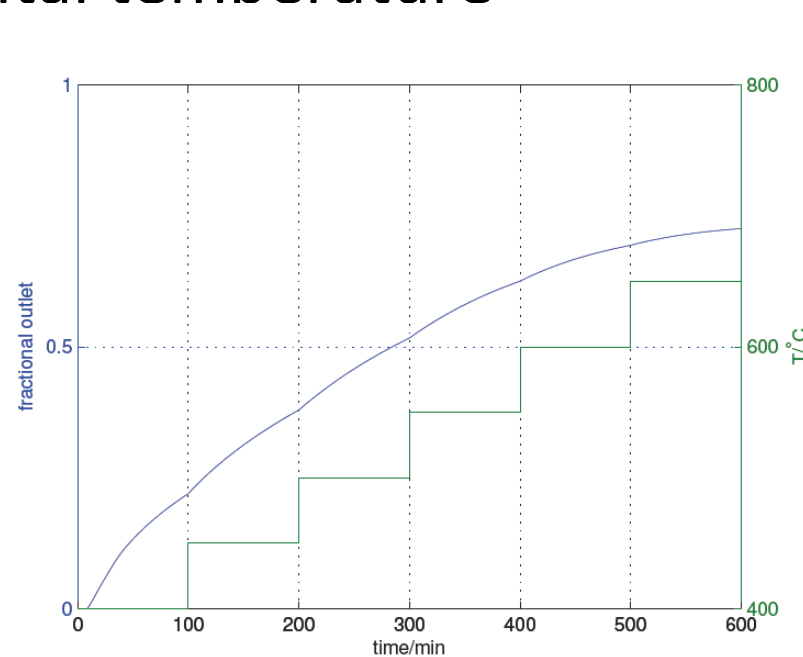
- To be performed at CERN- Isolde-Medicis (≈ 1.2 GeV)
- Using remote handling of tungsten block(s)
- Irradiation about $1E19$ protons in 10 days.
- Cool in the MEDICIS facility (5 days), then transport
- Subject to approval by Isolde Science committee (February 2016)
- (First) irradiation March 2015

Scaling the activity

- Up to 1 GBq I-125 at end of cool and transport
- Original experiment design is for ≈ 1.2 MBq
- Should we increase sensitivity by going for higher activity ? (Hot cell can handle this).
- ALAR / more experiments
- Other radiohalogens, - other isotopes
- "pre activation" small block to confirm activity level

Risks and Issues

- Time schedule for tungsten irradiation (to be fixed January 2016) – slated for March 2016
- Deciding the experimental temperature
- Sensitivity
- “exponential scaling”



Sensitivity



- Minimum detectable activity 0.2 Bq I-125
- Minimum detectable release fraction 20 MBq I-125

$$2E-1 / 2E7 = 2E-8 \text{ for 1 block}$$

- Uncertainty – mainly on low level of I-125 (20%?)
- Can be scaled by “higher temperature”

Concluding Remarks

- Agreement has yet been signed by ESS and DTU legal (after some months delayed)
- Experiment setup for release factor of radioiodine from irradiated tungsten has been completed .
- The temperature test and calibration of the heating system has been completed.
- A “cold” test using spiked ^{131}I is going to be done in a few weeks