



Association Days, 02.07.2010



ICIT Rm. Valcea

Tritium Technologies for the Fusion Fuel Cycle

ing. Stefan-Ionut SPIRIDON

Institute for Cryogenics and Isotopes Technologies Rm. Valcea





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Goals:

- to provide the skilled professional staff required for the realization and operation of the ITER Deuterium Tritium Fuel Cycle and for the tritium handling in ITER;
- to provide the optimum design, together with a profound basis of experience for safe operation;
- to defend and further strengthen the leading European position in the field.





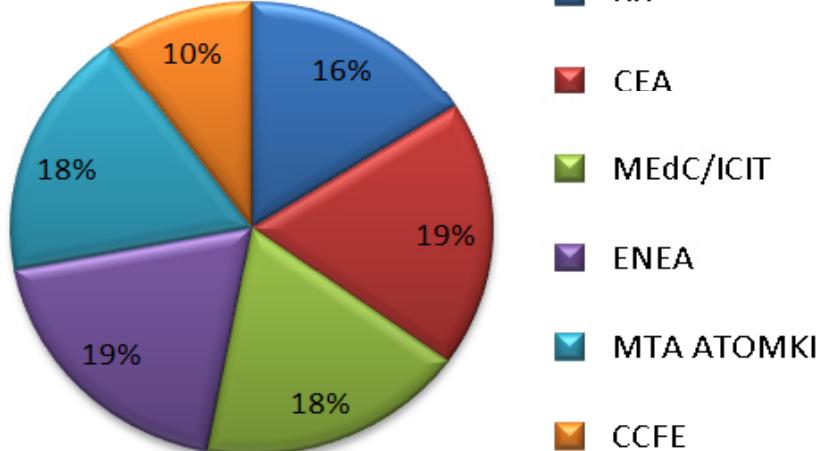
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Tritium Technologies for the Fusion Fuel Cycle – TRI TOFFY

PARTIES & COSTS

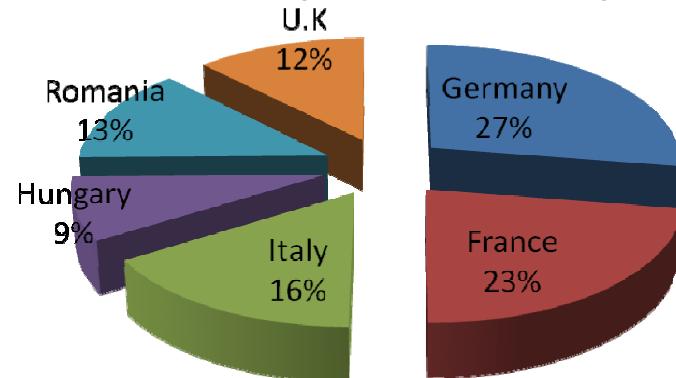
- KIT (Coordinator) - Germany;
- CEA - France;
- ENEA - Italy;

INDICATIVE MOBILITY SUPPORT



Community contribution for the benefit
of the project

40 % EU (858 000 euro)



- MTA ATOMKI - Hungary;
- UKAEA – United Kingdom;
- **ICIT Ramnicu Valcea – Romania**



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TRI TOFFY

3 year project: *Jan. 2009 – Jan. 2012*

- MEdC/ICIT Trainee - Work package No. 5, such planned:

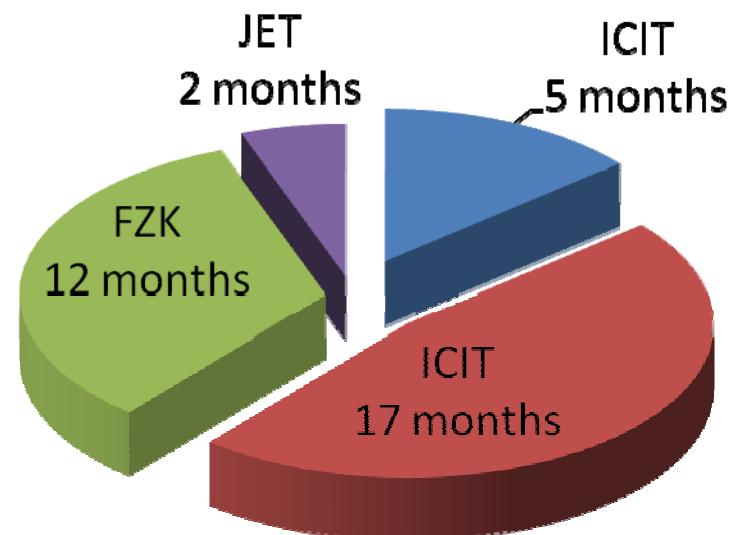
Introductory/accompanying training at ICIT
(duration: 5 months in total)

Research training at ICIT
(duration: 17 months)

Research training at FZK
(duration: 12 months)

Introductory training at JET Facilities
(duration: 2 months)

TOTAL: 36 months



Periods of training (months)



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Measures and Activities

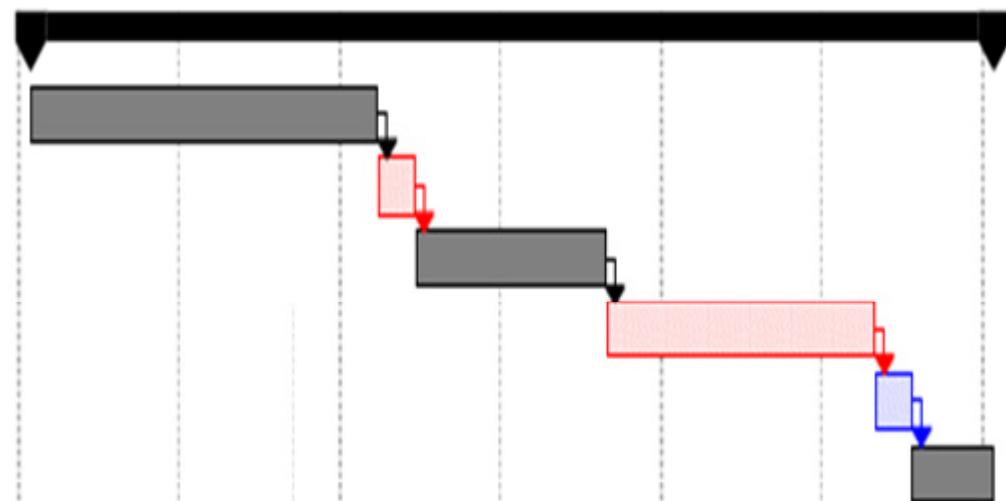
ICIT Rm. Valcea & Tritium Laboratory Karlsruhe (17 months + 12 months)

- Cryogenic distillation process
- Isotopic Separation process
- Material properties testing stands

JET Culham

- Combination of lectures, tours and practical activities

ICIT	Do 15.01.09	Fr 13.01.12
home #1	Do 15.01.09	Fr 12.02.10
TLK	Mo 15.02.10	Fr 28.03.10
home #2	Mo 29.03.10	Fr 29.10.10
TLK	Mo 01.11.10	Mi 31.08.11
JET	Do 01.09.11	Mi 12.10.11
home #3	Do 13.10.11	Fr 13.01.12





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Teoretical activities

- Become familiar with the process of water detritiation;
- Become familiar with the process of cryogenic distillation;
- Become familiar with BET surfaces measurements techniques;

Hands-on activities

- Measurements techniques in cryogenic plants;
- Participate in the experiments of ISS and WDS;
- Design activities;
- Development of the tritium extraction system according to the nuclear standards.
- Application of specific mechanical concepts in designing cryogenic equipments such as: heat-exchangers, condensers, etc.



TRI TOFFY



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Tritium Laboratory Karlsruhe – 12 months

Teoretical activities

- Learn specific measurement techniques in cryogenic plants, mainly temperature, liquid hydrogen flow;
- Improvement of sample taking techniques from the cryogenic distillation column
- Design specifications

Hands-on activities

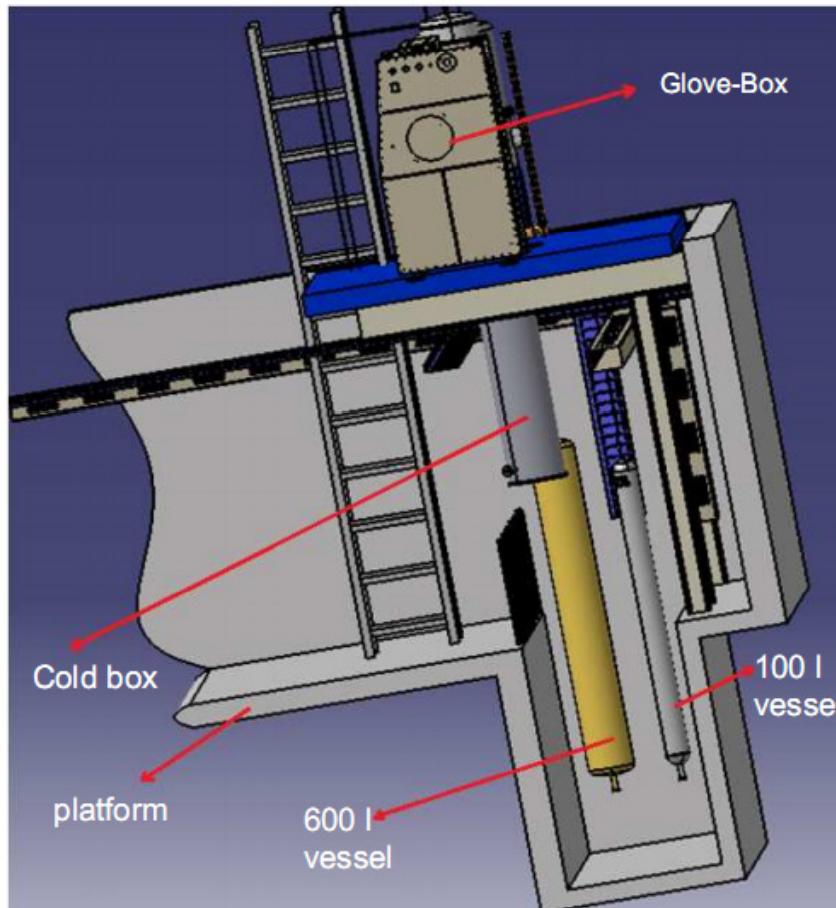
- Application of specific mechanical concepts in designing cryogenic equipments such as: heat-exchangers, condensers, equilibrators, heaters;
- Direct participation in the experiments with WDS and ISS systems;



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TRI TOFFY

Tritium Laboratory Karlsruhe – 45 days



The 3D model of CD Column platform

- A construction of a caisson was proposed at KIT-TLK as a second shell protection.
 - An isometric model of the CD Column platform was used for the construction of the caisson (for height, length), and also real measurements in the location of construction (using CATIA V5)
- Construction requirements for the caisson:
- The design solution should fulfill the nuclear safety regulation (after TLA No. 02/2007 – Technical Terms of Delivery and Acceptance of Glove Boxes and Similar Boxes for TLK);
 - Provide easy access from the top of the vessel caisson to the vessels and also access to the connection parts of vessels;
 - To have enough free space for the installation of another 0.3 m³ vessel;
 - To have low manufacture cost and to be easy to assemble;

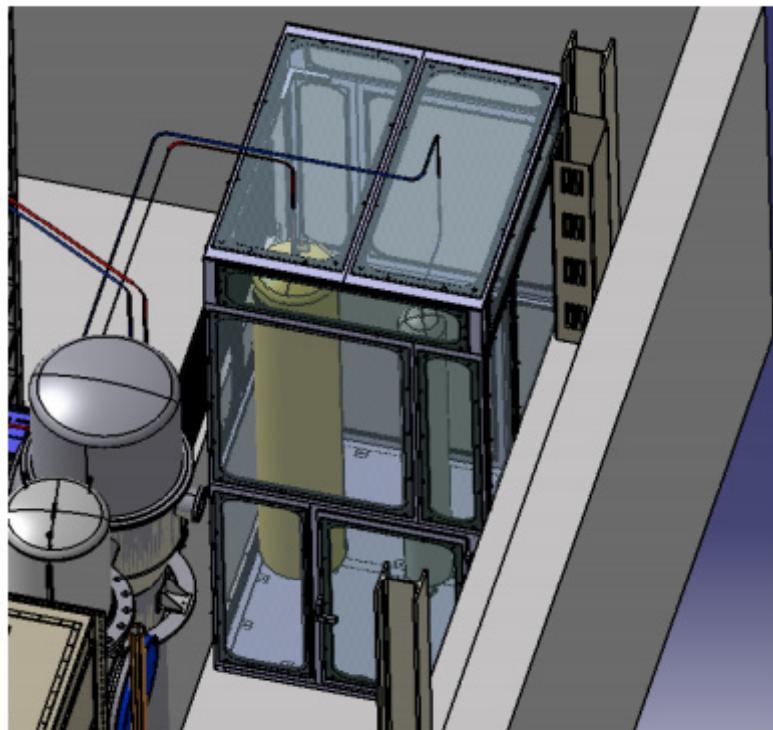


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TRI TOFFY

Tritium Laboratory Karlsruhe – 45 days

According to “Technical Terms of Delivery and Acceptance of Glove Boxes and Similar Boxes for the Karlsruhe Tritium Laboratory” TLA No. 02 / 2009 this is a 2nd shell – a component enclosing the 1st shell



The 3D model of the proposed caisson



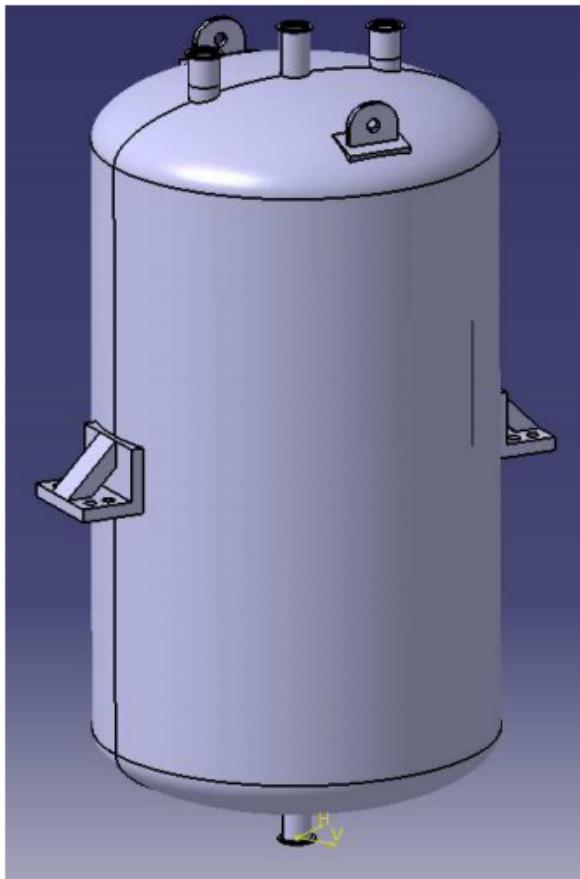
The 600 litres and 100 litres vessels



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TRI TOFFY

Tritium Laboratory Karlsruhe – 45 days



The 3D model of the 0.3 m^3 vessel

- According to the required safety standards in cryogenic facilities in order to have a secondary purge safety system for undesired leakages of tritium from installation at KIT-TLK, a specified vessel of 0.3 m^3 volume is needed to be constructed also in the caisson with the other two vessels.
- A 3D model of the vessel was made using CATIA V5 after a preliminary calculation of the vessel components.

Concept requirements:

- To be done according to the required safety standards
- Need of easy positioning supports that fits the caissons available space;
- To have the required volume of 0.3 m^3 ;
- Have the possibility to manufacture from standard market components (fittings(TU40K70-316), plates, end caps (DIN28011), etc.);
- Try to have a efficient construction solution for best quality, price and nuclear safety;



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TRI TOFFY

Tritium Laboratory Karlsruhe – 45 days



ICIT packing

- Participation to a test session regarding the ICIT packing (on the CD column in KIT).
 - Compared to the CD columns installed and tested at TRENTEA4-pre before, the new CD column used for tests has a modified simpler design;
 - The new column design was chosen to identify any constructional influence on the performance and the liquid hold-up on the packed sections;
 - In test we have determined the separation performance, expressed by the HETP (height of equivalent theoretical plate) and the liquid hold-up of the packings under total reflux conditions;
- The new CD column only consisted of :
 - a tube of 1200 mm length and an inner diameter of 50 mm (packable section)
 - two flanges for the connection to the injection unit and the reboiler;
 - no additional feeding lines, sampling lines or connections for TVO (temperature) sensors were along the column.
 - was filled with 23 packing units, resulting an effective packed length of 1,15 m
 - the used mixture of 30% D₂ and 70% H₂





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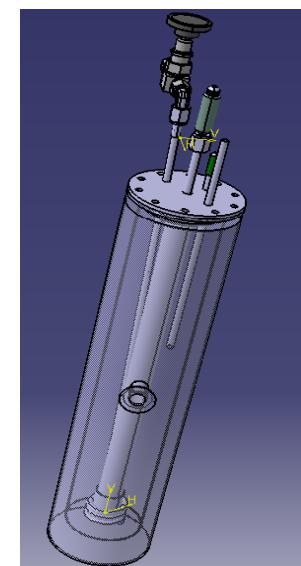
TRI TOFFY

ICIT Ramnicu Valcea – second phase 6 months



Minimum Absorption Rate Determination Rig

- Involvement in test regarding determination of the minimum absorption rate in catalysts of activated charcoal :
 - designing a 3D model of a absorption rate test bench in CATIA V5;
 - participation to the physical assembly of it and the tests with the activated charcoal as main probe for minimum absorption rate determination;
 - notice that absorption time has increased directly with the decrease of temperature
 - temperature in the charcoal absorber resulting a big variation in absorption time and absorbed quantity of H₂



3D model of Absorber Unit





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Participation to courses :

- “Membranes for Fusion Fuel” Course (2 days):
 - Introduction to membranes and membrane reactor
 - Introduction to the Pd/H system
 - Pd-based membranes synthesis and characterization
 - Modelling of Pd membrane reactors
 - Process applications of Pd membrane reactors
 - Pd-based membrane reactors applications at the European laboratories
- Advance CATIA course (4 days) consisting in:
 - Equipment Arrangement;
 - Piping Design;
 - Piping Setup - ISOGEN





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JET Facilities – 2 months

- Participation in different operational procedures during experimental campaign;
- Become acquainted with the various working fields activities at JET like:
 - deuterium processes;
 - gas analysis;
 - tritium measurements.
- Become familiar with:
 - tokamak physics and operation;
 - fuelling, particle transport & confinement;
 - fuel recycling and hydrogen retention.





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Thank you for your attention !

