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Status of the NGKB – Background information

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IAEA Nuclear Graphite Knowledge Base

…graphite data and knowledge portal

Overview

- The IAEA Nuclear Graphite Knowledge Base
  - Why?
  - What is in it ?
  - Status and features
  - Further development



Knowledgebase – History



- 1995: issue of potential ‘loss’ of knowledge highlighted at IAEA Specialist Meeting in Bath, UK
- IAEA commissions Tony Wickham to prepare a proposal for debate at TWG-GCR – accepted, but no funding
- UK nuclear regulator recognises value for UK reactor life extension and agrees to fund the development and start-up
- Database formally commenced in 1999 with UK handing full development and IPR to IAEA
- Current membership: Germany, Japan, Rep. Of Korea, Lithuania, The Netherlands, The United Kingdom, The United States of America , P.R. China, Ukraine
- Funded by in-kind contributions from graphite manufacturers over the last few years and ad hoc IAEA funding
- The initial focus of the NGKB was to find and archive irradiated nuclear graphite data, but over time the scope widen.

IAEA Nuclear Graphite Knowledge Base



Databases



http://nucleus.iaea.org/sites/graphiteknowledgebase/Pages/home.aspx

Mission Statement



- to support the preservation and sharing of expert knowledge and experience, across the international Nuclear Graphite Community.
- We seek to learn from the behaviour of existing graphites how new graphites will behave and how existing graphites will perform at fluences we have not yet reached

- Membership is open to all IAEA member states (on acceptance by members / on application)
  - Funding models needs to be addressed to continue the effort
  - Open access to information under discussion

- Should be further developed into a knowledge base (beyond a irradiated graphite repository only of value to experts)

A	B	C	D	E	F	G	H	I	J	K	L
SAMPLE CHARACTERISTICS											
Graphite Grade	Sample Number		Orientation	Manufacture	Coke Source	Binder	Filler	Number of Impregnations	Impregnant	Forming Process	Graphitisation Temperature (°C)

M	N	O	P	Q	R	S	T	U	V	W	X
SAMPLE CHARACTERISTICS				CRYSTALLITE PARAMETERS							
on Additional Information	Neutron Fluence (dpa)	Irradiation Temp (°C)	Irrad. Experiment	a Initial (10^{-10} m)	a Final (10^{-10} m)	c Initial (10^{-10} m)	c Final (10^{-10} m)	La Initial (10^{-10} m)	La Final (10^{-10} m)	Lc Initial (10^{-10} m)	Lc Final (10^{-10} m)

Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ
ELASTIC PROPERTIES											
	E-Modulus (Static)			G-Modulus (Static)			E (Dynamic)		E (Dynamic)		
Initial E_0 (GPa)	Final E (GPa)	Final/Initial	E/E_0-1 (%)	Initial (GPa)	Final (GPa)	Final/Initial	Initial (GPa)	Final (GPa)	Final/Initial	E/E_0-1 (%)	Initial Frequ. (10^3/s)

AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
ELASTIC PROPERTIES						ELECTRICAL RESISTIVITY					
		G (Dynamic)		Poisson's Ratio					Fractional	Measuring	
Final Frequ. (10^3/s)	Initial (GPa)	Final (GPa)	Final/Initial	Initial	Final	Initial (Ohm*m*10^{-6})	Final (Ohm*m*10^{-6})	Final/Initial	Change (%)	Temperature (°C)	Initial (10^{-6}/K)

AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH
THERMAL PROPERTIES											STRENGTH
Thermal Expansion Coefficient					Thermal Conductivity				Tensile		
Final (10^{-6}/K)	Temp Range (°C)	Final/Initial	Fract.Chang (%)	Initial k_0 (W/m K)	Final k (W/m K)	k/k_0-1	Meas Temp (°C)	Initial (MPa)	Final (MPa)	Final/Initial	Initial (MPa)

BI	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT
									DIMENSIONAL CHANGES		
Compr. Final (MPa)	Final/Initial	Initial (MPa)	Bending Final (MPa)	Final/Initial	Initial (mm)	Length Final (mm)	Change (%)	Initial (mm)	Diameter Final (mm)	Change (%)	Thick 1 (mm)

BU	BV	BW	BX	BY	BZ	CA	CB	CC	CD	CE	CF
				ACOUSTIC PROPERTIES				IRRADIATION CREEP			
ness 2 (mm)	Initial (cm^3)	Volume Final (cm^3)	Change (%)	Sonic Velocity Initial (m/s)	Final (m/s)	Atten uation Initial (db/mm)	Final (db/mm)	Applied Stress (MPa)	Creep Strain (%)	Creep Coeff (10^{-35}*m^2/Pa)	

CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR
STORED ENERGY			PORE VOLUME		DENSITY			OTHER PROPERTIES			
		Release	Open Porosity					Initial Mass	Final Mass	Mass Loss	
Total S (J/g)	dS/dt (J/(g*s))	Start Temp (°C)	Initial (%)	Final (%)	Initial (g/cm^3)	Final (g/cm^3)	Change (%)	(g)	(g)	(%)	Ordinal Number

Microsoft Excel - Demonstration Sept 05.xls

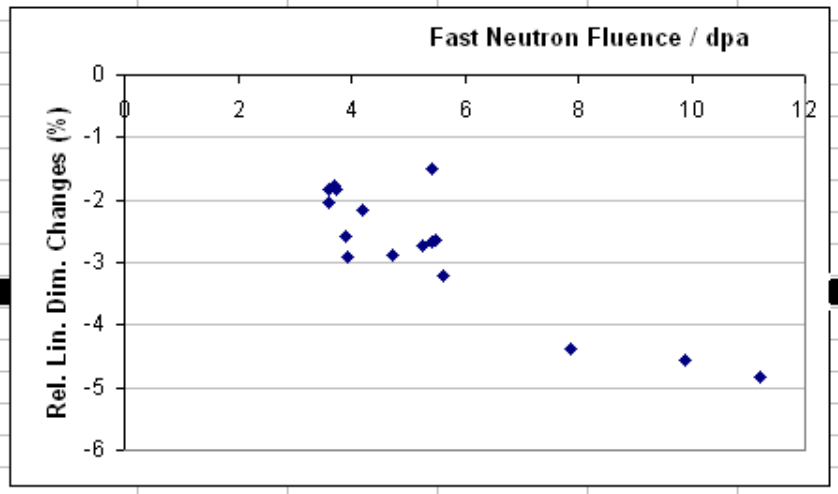
Datei Bearbeiten Ansicht Einfügen Format Extras Daten Fenster ?

Arial 10 F K U 100%

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BP19 =

	A	B	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW
19						DIMENSIONAL CHANGES						
20				Length			Diameter		Thickness			Volume
21	Graphite	Sample	Initial	Final	Change	Initial	Final	Change	1	2	Initial	Final
22	Grade	Number	(mm)	(mm)	(%)	(mm)	(mm)	(%)	(mm)	(mm)	(cm^3)	(cm^3)
23												
24	1	PI6.B.BA			-0,435							
4899	PF	PF.A.AC			-0,18							
4900	PGA	L14.A.FSB			-2,90							
4901	PGA	L14.A.IGH			-2,58							
4902	PGA	L14.A.DIM			-4,39							
4903	PGA	L14.A.CE			-2,63							
4904	PGA	L14.A.CC			-2,73							
4905	PGA	L14.A.CD			-2,66							
4906	PGA	L14.A.CE			-1,83							
4907	PGA	L14.A.CC			-1,84							
4908	PGA	L14.A.CD			-1,78							
4909	PGA	L14.A.CF			-2,04							
4910	PGA	L14.A.CG										
4911	PGA	L14.A.DIN			-4,56							
4912	PGA	L14.A.DIO			-4,82							
4913	PGA	L14.A.FSC			-3,20							
4914	PGA	L14.A.IGI			-1,49							
4915	PGA	L14.A.DIA			-2,17							
4916	PGA	L14.A.DIB			-2,87							
4917	PGA	L14.A.DIC			-2,50							
4918	PGA	L14.A.DIP			-4,88							
4919	PGA	L14.A.DIR			-4,64							
4920	PGA	L14.A.IGK			-2,34							
4921	PGA	L14.A.FSD			-3,04							
4922	PGA	L14.A.DID			-2,22							



TC 300-rev.xls

Zeichnen AutoFormen

Bereit Summe=766,00 NF

Current status of Nuclear Graphite Knowledge Base

- The knowledge base contains two levels of knowledge:
  - General information on the subject of Nuclear Graphite
  - Specialist knowledge, secured for members of the international project
  - All data captured in … Microsoft Excel (>34,000 lines)
  - Links provided to source documents and Quality evaluation



- The Nucleus Sharepoint site is hosted and maintained by IAEA
  - The Creep CRP data must still be fully incorporated
  - New historical data is found
  - Quality evaluations needs to be performed
  - Annual committee meeting needs to be held
  - New irradiation data can be added when made available

Future of the Nuclear Graphite Knowledge base



- The IAEA has developed expertise and methodologies for knowledge management in the nuclear field
- Information technology has also improved considerably during the past few decades and it can be used to maximize the value of the KB for its members and the international community.
- The possible further development of the KB in a form that facilitates more effective search and use of the stored information will be investigated.
- This includes aspects like the planned development of the taxonomy and utilization of automated tools.

Path to a knowledge base

- The path to transform the NGKB into a modern, user-friendly knowledge base has just started.
- The IAEA Knowledge Organization System is being refined and implemented in other domains, so the lessons learned can be applied here.
- As a first step, it is important to develop tools, such as subject area taxonomies, or ontologies, used to describe a knowledge domain.
- For example, the knowledge portal can be integrated with a taxonomy-based search tool, sometimes referred to as a “semantic search,” that leads to the retrieval of more relevant documents.
- The taxonomy should be developed to comply with international web standards as defined by the World Wide Web Consortium (W3C).

Developing first taxonomy

- taxonomy is being developed and tested using papers presented at the INGSM as a starting point.
- implemented to demonstrate the functionality to the steering committee members.
- can then be further developed and documented and published as a TecDoc
- was developed with the assistance of subject matter experts attending a consultancy meeting
- A rapid, but less comprehensive, approach was followed ….. because the initial focus was to demonstrate functionality on the INGSM archive material only

Developing first taxonomy

- keywords provided by the experts with their papers were use as a starting point
- a selection of keywords provided by nuclear graphite experts at the beginning of the meeting was added
- more than 300 keywords were printed on small cards, and proposed keywords were written on sticky notes.
- keywords were then reduced, grouped and refined in classes or members of classes (instances) while being ordered into clusters.
- This process repeated over several sessions
- resulted in the first draft of a taxonomy that was captured in an Excel spreadsheet and also taxonomy editor.

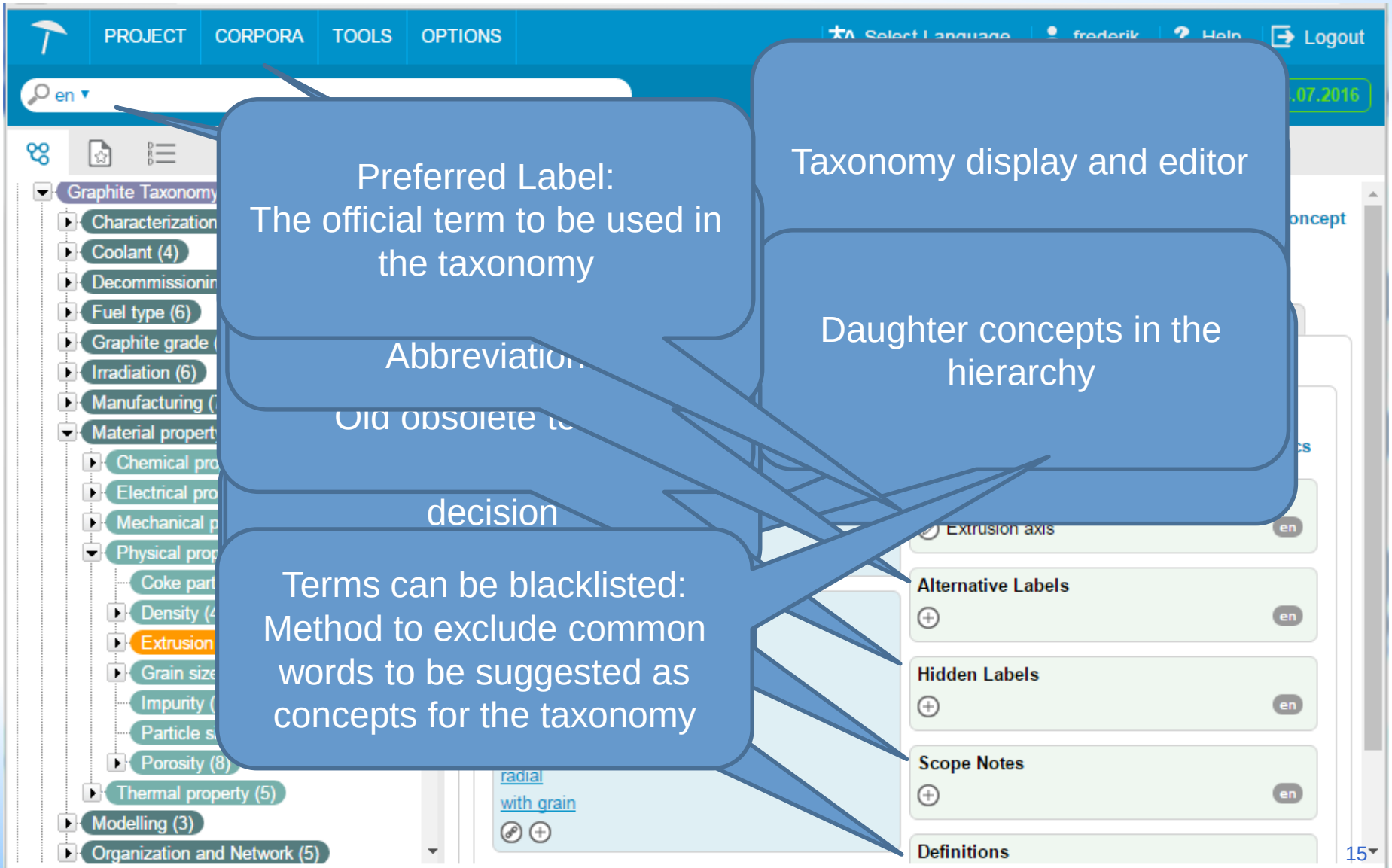




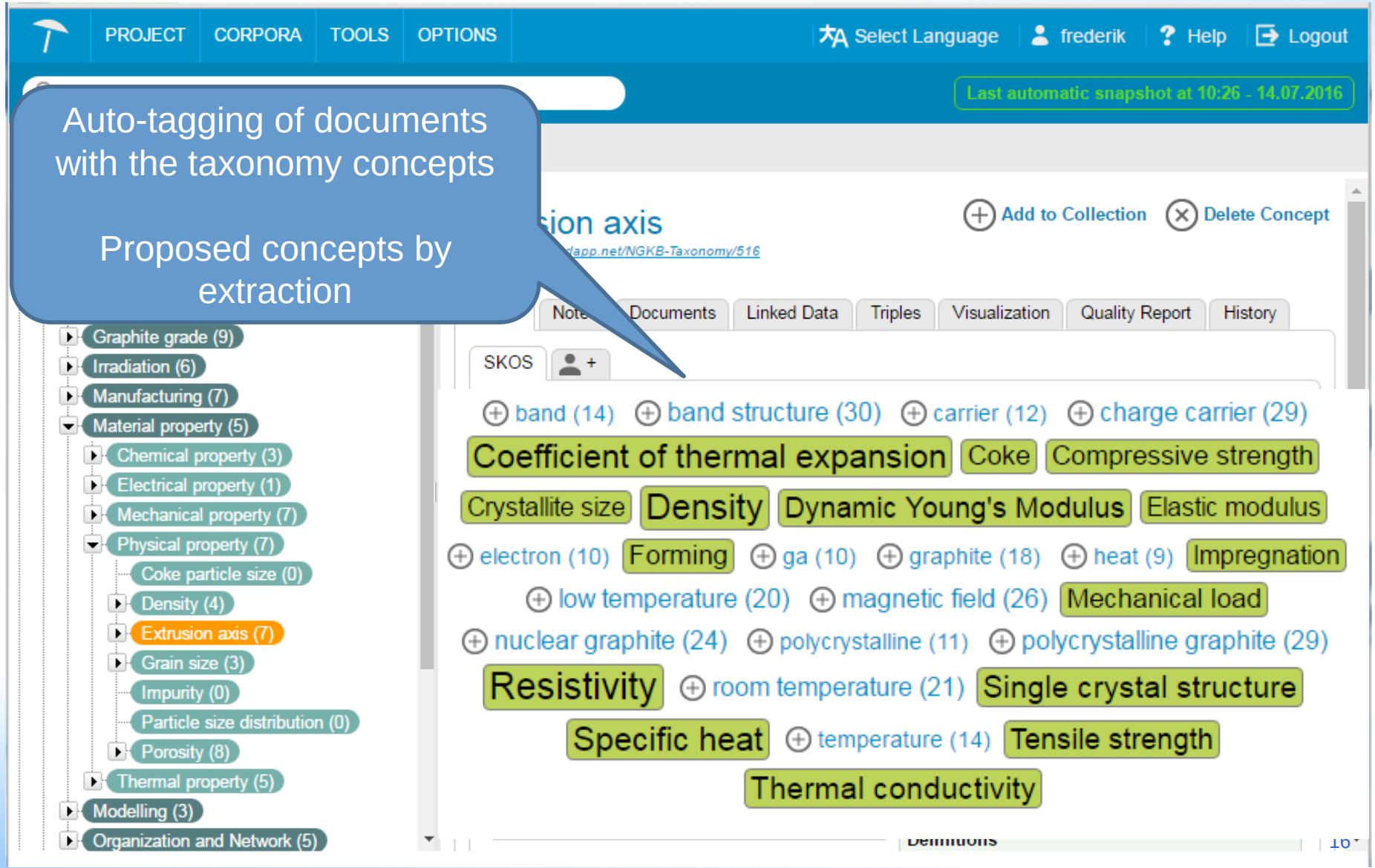
Developing first taxonomy

- Use cases can enrich the taxonomy by linking to or referring other sources of information.
- The use of definitions from other websites is one example.
- Additional concepts were identified and added (also using proposed terms from software tools).
- The extracted terms were ordered in super- and subclass hierarchies.
- For each class, the properties or attributes were defined so that they could later be enriched by linked open web data.
- During the meeting, a hierarchical taxonomy draft was developed. The draft contained over 300 concepts, grouped into 15 top-level concepts, each up to 4 or 5 levels deep.

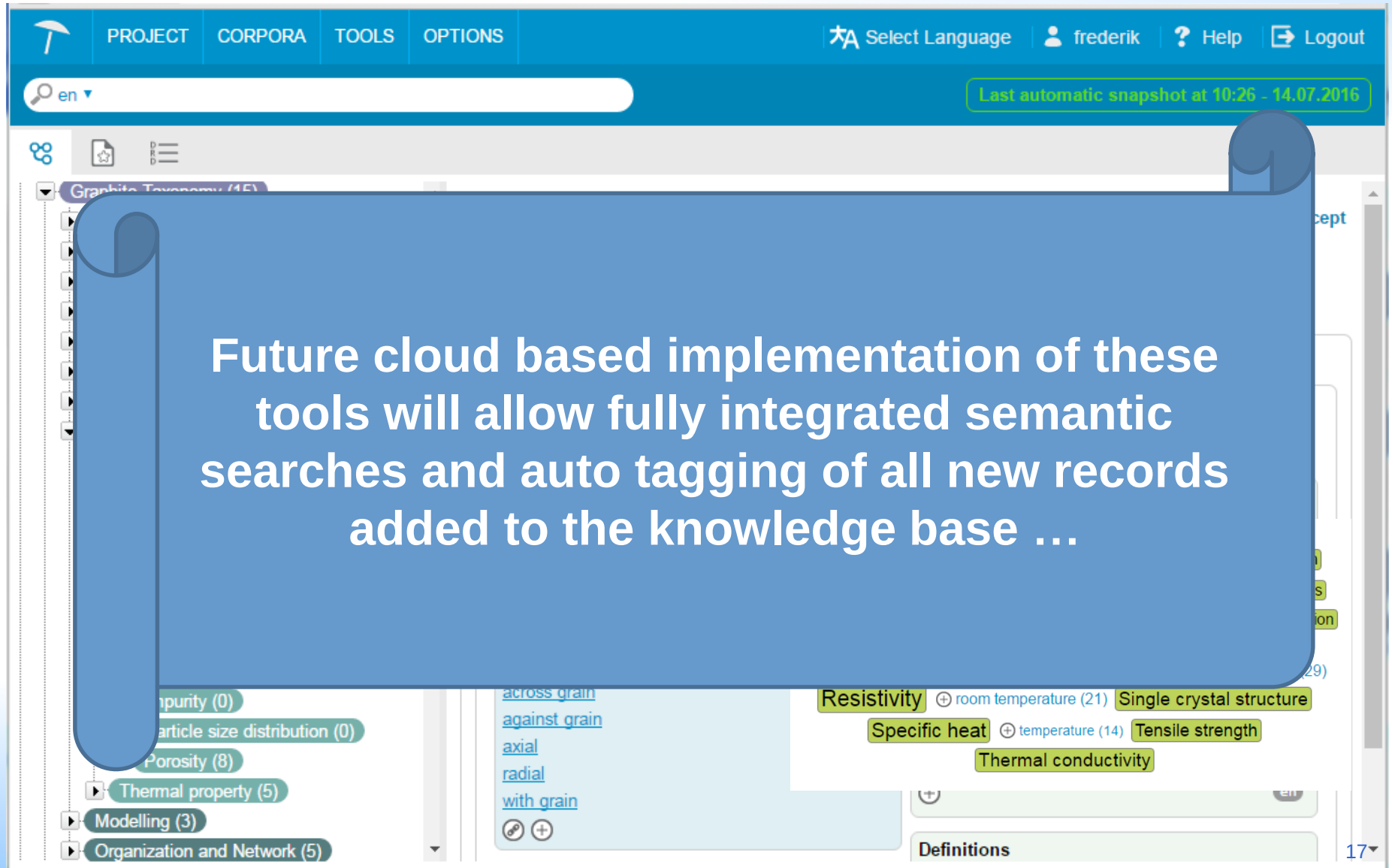
Advance features / PoolParty



Advance features / PoolParty



Advance features / PoolParty



Conclusions

- The NGKB represents a massive effort by dedicated graphite experts over the last 20 years.
- It contains a wealth of nuclear graphite irradiation data and other substantial sources of knowledge.
- The data have been archived and expert judgement has been made on the quality and reliability of the data
- The IAEA continues to support the knowledge base.
  - The modernization process continues
  - It is enhanced using the in-house knowledge preservation drive and the existing KOS.
- Steps already done:
  - a first taxonomy for the expert subject area was created.
  - the use of modern knowledge management approaches
  - the additional value it offers was recognized and emphasized.
- The NGKB should be further promoted
  - to contain quality information on nuclear graphite, past and future
  - To become the preferred source of information for the nuclear graphite community.

.. but are critically re-evaluating its role and relevance

- Extra-budgetary funding from graphite manufacturers decreased – huge effort to get these extra-budgetary donations
- IAEA tedious recruiting process makes contracting difficult – last sets of historical data not yet included (and possibility fading)
- NGKB urgently need more data (new and old) to be submitted to make it more relevant to future HTGRs
  - Data still missing from some members
  - France, Russian Federation never joined
  - South Africa – I confirm have some virgin graphite data *(no irradiation)
  - Most new data seems to be confidential? (in GIF handbook?)
- The molten salt reactor community (SINAP) getting more involved
- Membership to be opened (secretary need to get new ToR approved)
- Need improved graphite “database” for non-expert users
- Other funding streams including regular budget….
- …. etc

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Thank you!