

**Smarter Plant Decommissioning** 



### WASTREAM for supporting the dismantling of nuclear installations

ICEM2023, William ARSAC, Robin THOMAS, Nicolas DELANNAY, Thibaut HELMAN, Tractebel

william.arsac@tractebel.engie.com, robin.thomas1@tractebel.engie.com



This project has received funding from the EURATOM Research & Training Programme 2014-2018 under the Grant Agreement n°899990. The content of this document reflects only the author's view. The European Commission is not responsible for any use that may be made of the information it contains.



### Agenda:

- 1. Introduction
- 2. Description of main tools :
  - 2.1 PLEIADES platform
  - 2.2 WASTREAM software suite
  - 2.3 Interaction PLEIADES/WASTREAM
- 4. Methodology
- 5. Results
- 6. Conclusion





### **1. Introduction**

- The PLEIADES project aims at connecting digital tools for smarter nuclear decommissioning
  - Databases and ontology
- The WASTREAM software suite (Tractebel)
  - Used as support decommission projects  $\rightarrow$  Estimation of waste fluxes
- The work presented aims at demonstrating how Tractebel developed a synergy between WASTREAM and PLEIADES databases → waste estimation using PLEIADES framework





### **2.1 PLEIADES platform**

- European initiative
- Common data environment for dismantling projects:
  - Structured database (+ dismantling ontology)
  - File database → store any type of file format
  - Identity and access management
  - Connection via web browser or API

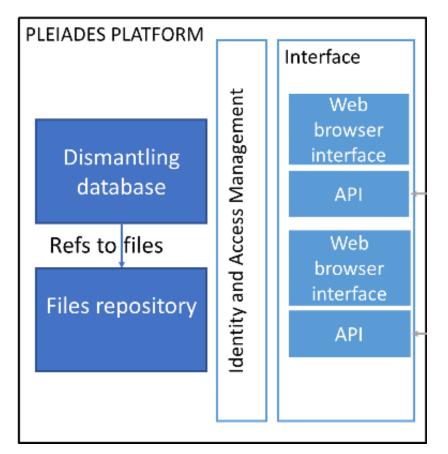


Fig1 : Graphical representation of the PLEIADES Platform





### **2.2 WASTREAM software suite**

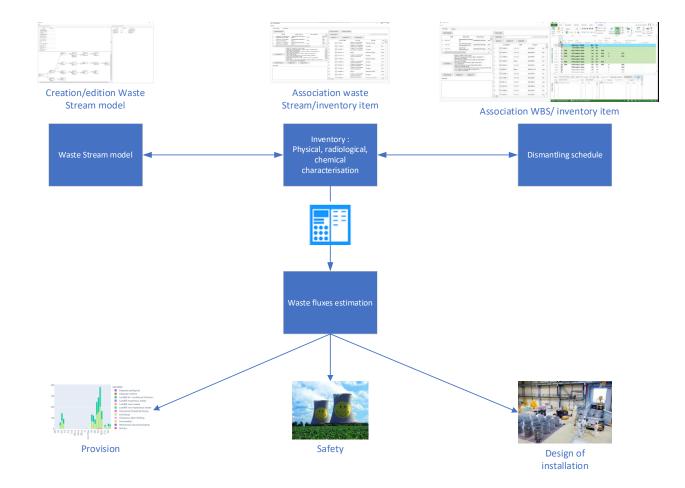
#### The WASTREAM software suite allows:

- Define waste stream models
- Establish the link between the installation physical inventory, the waste streams and the dismantling planning
- Calculating / analyzing / visualizing the quantities of waste produced
- Fast running and compatible with a wide variety of physical inventory databases / dismantling schedules





### **2.2 WASTREAM software suite**

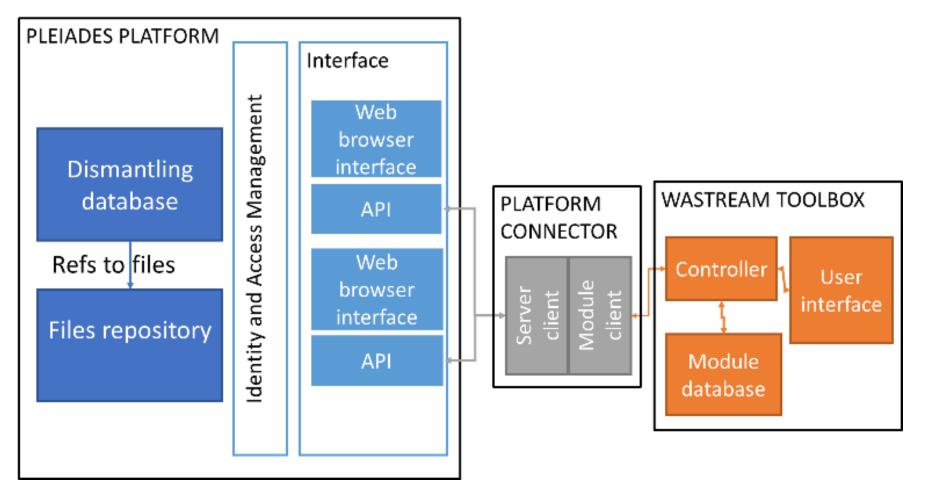






6

### **3.1 Interaction PLEIADES/WASTREAM**







### 4. Methodology

- 5 Steps
- Proof of concept using data from other PLEIADES participants
  - Start from IFC 3D model (BIM)
  - Synergy WASTREAM ↔ PLEIADES platform
  - Synergy between EU operators
- Optional: incorporate the results back into the IFC 3D model





## 4.1 Loading of physical and radiological characterization in PLEIADES database

- Starting point = 3D model containing:
  - Physical characterization
  - Radiological characterization (dose)
    - Activation
    - Contamination
- WASTREAM automates transfer of inventory items to PLEIADES
  - Entries created in PLEIADES structured database
  - Radiological (activity) and physical characterization

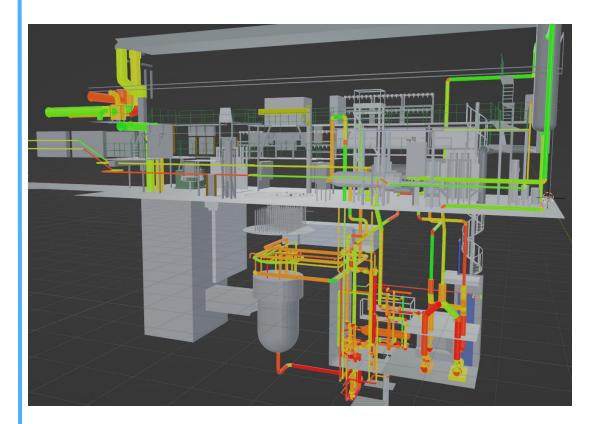


Fig 4 :visualization of pipes activity in HRR model (Green: low activity, Red: high activity. fictive data) [HALDEN]



9

### 4.2 Definition of the waste stream model

- Waste stream model defined using WASTREAM:
  - Node (square shape):
    - Entry / treatment / exit
  - Arrows:
    - Link between operation
    - Mass / Activity ratio
- Complete model stored in file database
- Entry points stored in structured database

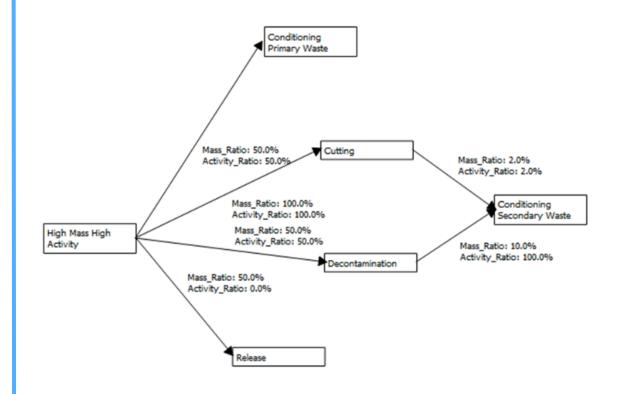


Fig5 : Graphical representation of the waste stream model



### 4.3 Definition of the planning

- The scheduling of dismantling works defined using software like Microsoft Project
- Following a WBS structure
- Each task are stored in structured database

					8	9 - (* - +	DECOM, Milkingg (head Only) - Project Performant	MEAC WINAH (TACTUR) - BELEAM 💿 - 0
Letter Carsala					The	Tesh Resource Report Project View Hat	Hip Gant Chart Format 🖉 Tell the what you want to ito	0
m lainted	Autor for 19885				5	Ph 100	00000 ******* * *	Pristoner Distant Distant -
	Apple Titler				- 64	And Digney +	Th Argent Line Party and Line Line Line	Pristanny Ditter
	Salari Al Da	Institut of Asset Filer			Chart *	- #famathamar 🔳 / 1 2 2-4-		· 10 Innerstante - In test Data -
	metal.	WITED DEJET, MAN UUED Swith	what BURDING NAME ROOM NAMED	IN MARTERIAL LUMAA, NAME	6 (1 <sup>-1</sup> )	dataset for 4	6 Under Inde	Next Projection Life Manage
	a 52 100-	10-4 Start mutters _ stitution line _ 17, 178	c 10.3 006	15 (347-888-8		Tank a 40 a 177 m <sup>2</sup> a Notes	S Const. (1v) . Tab Name 2011	2024
	1 17 19 10	151 Dest markets . attraction. 17, 178	C 81 852	C5 (347-888-8	101 10	1 118	m - DECOMMISSIONING Period 8 - EXECU	
		4.6.2 Seet markets . ditables class. 171, 578		G 007-00-0	10 10	13	Ph HDH Doeld	
					10	-	en scoul Doell2	
	3 23 100-1			C5 CN7 089-0	135 150		Bi HCB4 DoelH	
wind <sup>4</sup> Pite Men, exc.	4 12 1014	191 See mature - d146ka-25e. 55,578	C 963 (892	CS CM ###+4	10 10	27 Here	PN CNT2 + Tibange2 Ph CNT2 Disnanting of Components & Systems during	Dismantling of Components &
	3 12 1025	5-10-1 Entended stee. ##9190 Jack. (MBE)	103 003	C5 Chf 889-0	100 00 00		m (9/2 Removal Advantas + Dargement Editorama	Removal Auberton - Dangerton Substance
	4 52 1025-0	1-9-1 Start mutures . at1482xa-23xa. 17, 176	C 16.3 (852	CS Chil 488-0	10 3.0	10 Future 15423	2% Cooling Towar structure Dismanting	© Cooling Tower structure Dian
	7 12 100-0	14.1 Start mutters . attration line. 10, 178	C 101 001	CS CNT 000-0	· 1 ·	10 100	BN CNT2 - Appeal Time	
	a 12 mm	101 See markers . dl148hzadles. 17, 178	c 10 10	C5 CM-00-0	100 8 17	E fairs 1008	(%) (%7) Liternal anap 12	Lisamae asap 12 y 25/08/25
						10 have 1000	0% ORT2 Exemut 12 8% ORT2 + Preparatory Works Elect	License 12 + 20/08/26
		1.9-1 Seet structures - st514Elco-Uses. \$71,578				to here and	DN (3072 Preparatory Works Stat	Preparatory Works
		114 3mi mutum - di Mito-Im. 17,578		CL CN7 889-1	10 17	the last last	DN. CMT2 Auffer PW	Buffer PW
Droging Unlique 40 August 40	11 23 3024-0	5.5.1 Steel etuchanes dl.14Elica-22ea 571,578	C 163 887	C5 CN7 889-0	100 122	2 falant 2024	IN 085 814	1
ee hee	N2 🖾 300-4	19-2 Seet stuctures 4514Elica-22ex 571,578	C 16.3 1000	CS CNT-999-0	10 17	I Ann Hall	0% CN72 MPV	1 APV
	13 22 1002	19-1 Steet markets - 4014Eka-Lina, 101,578	C 103 INI	15 00 889-0	10	a and a start	DN CNT2 + Cald & Dark Stat DN CNT2 Cold& Dark	Coldb Dark
	14 ST 100.4	1-5-1 Seef structures - s01482/ca-22ea. 17, 578	E 10.2 000	C5 (327-888-0	100 000	a los los	0% 082 Contractors	Buffer (D
		1-5-1 Dest structure _ stilling line _ 17, 178		05 047-898-0	100 100	10 MM 100M	IN ONTE + PS Sket	
		5 10-1 Embeddied dam, defythild Zing, DMED					1 1	
			3(3) 508	C3. Ch2 486-0		a theysi (and a 2	Stor Store Specially Sheddard Roomers Reg	
	and the second se	19-2 Steel structures - 401483ca-22ea- 57,578	C 80 800	C3 C07 899-0	10 E 14	a farmerica - June Mercercon	- happe furthers - aligned in 2	
	18 12 108	10.1 Evidential des. 249790-Des. DMBD	10.3 006	CS CN7-899-0		E Parkener New York Lag *	B Annual New York Log P	
	27		a an 11-11		···			



# 4.4 Association of assets/waste stream/WBS

- Association performed using WASTREAM
  - Read Pleiades structured database (API)
  - Follow document\_id link recursively
  - Produce a flat table
  - Filtering
  - Write association in structured database
- Filter stored in document database (traceability, reuse, ...)

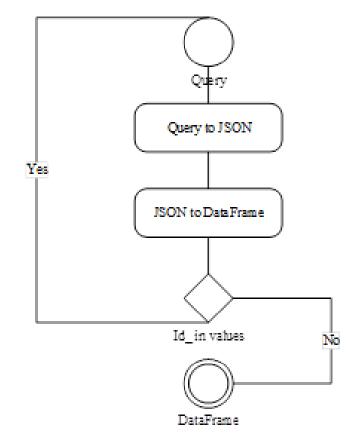


Fig5 : Graphical representation algorithm used to produce a flat table from the structured database



### 4.5 Calculation (waste estimation)

- Input information stored in document and structured database
  - Document: waste stream model
  - Structured:
    - Characterization data association
    - Waste Stream association
    - WBS (planning) association
- The calculation leverage matrixial operation  $\rightarrow$  fast running
- Results stored in structured database:
  - For each inventory item mass and activity split over all the waste stream model (parent child association)





### 4.6 Optional: 3D model enrichment

- Estimations obtained from WASTREAM can be pushed back:
  - To other Pleiades structured database
  - To file database
- Initial 3D model can be enriched (BIM) :
  - Waste estimation
  - Dismantling date

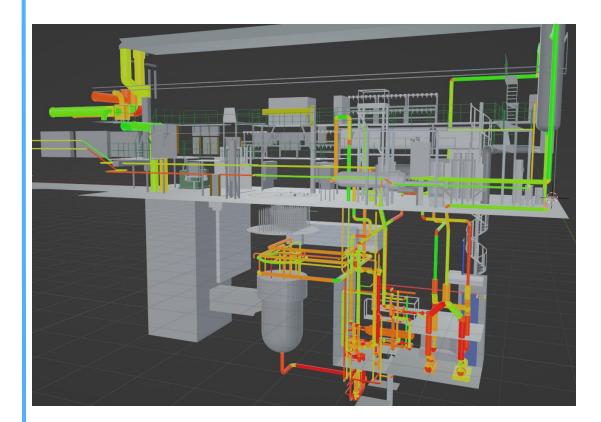


Fig 6 :visualization of pipes activity in HRR model (Green: low activity, Red: high activity. fictive data)



### 4. Methodology: Summary

- 4.1 Loading of physical and radiological characterization in PLEIADES database
- 4.2 Definition of the waste stream model
- 4.3 Definition of the planning
- 4.4 Association of assets/waste stream/WBS
- 4.5 Calculation (waste estimation)
- 4.6 Optional: 3D model enrichment





### **5.1 Results: input preparation**

- IFC model → structured database
- Tree waste stream:
  - High mass high activity
  - High mass low activity
  - Low mass low activity
- Association with WBS / waste stream



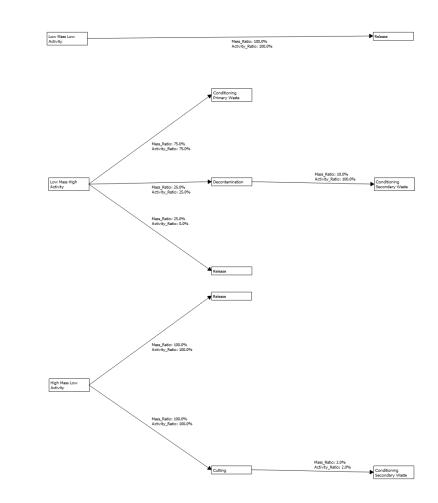


(÷, ́,

16

### **5.1 Results: input preparation**

- IFC model → structured database
- 3 waste stream:
  - High mass high activity
  - High mass low activity
  - Low mass low activity
- Association with WBS / waste stream

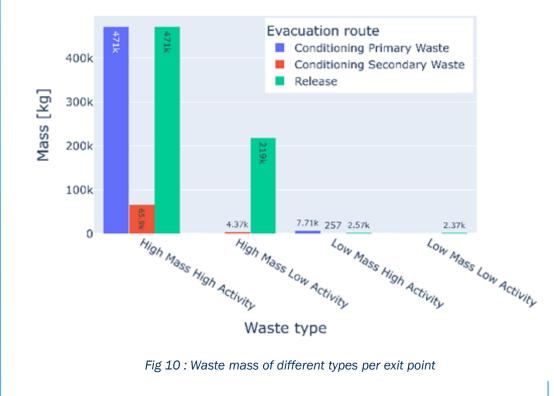






### **5.2 Results: waste fluxes estimation**

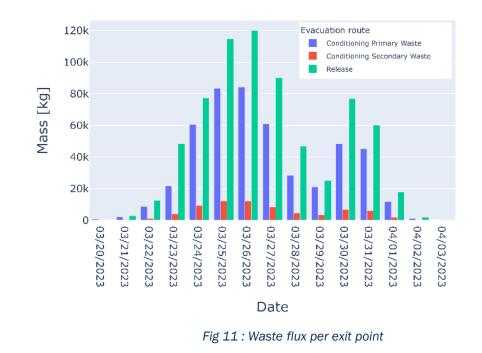
- Waste stream allows to
  estimate waste masses / fluxes
- Fast running calculations ease sensitivity studies :
  - Evaluate the impact of specific parameters
  - Comparison of waste fluxes
    management options
  - Addition of new constraint coming from external stakeholder





### **5.2 Results: waste fluxes estimation**

- Waste stream allows to estimate waste masses / fluxes
- Fast running calculations ease sensitivity studies :
  - Evaluate the impact of specific parameters
  - Comparison of waste fluxes
    management options
  - Addition of new constraint coming from external stakeholder





19

### 5.2 Results: waste fluxes estimation

- Waste stream allows to estimate waste masses / fluxes
- Fast running calculations ease sensitivity studies :
  - Evaluate the impact of specific parameters
  - Comparison of waste fluxes
    management options
  - Addition of new constraint coming from external stakeholder

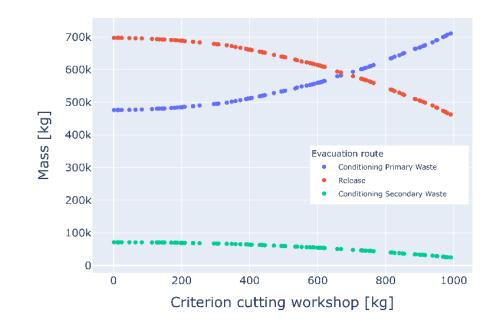


Fig 12 : Waste mass of different types per exit point in function of criterion from cutting workshop





### 6. conclusion

- Purpose of the study :
  - Test connectivity and adequacy of PLEIADES database structure / platform
- WASTREAM software suite developed by Tractebel is able to connect to PLEIADES platform to:
  - Produce waste estimation calculations
  - Provide guidance to decision makers
  - Support the preparation of dismantling activities/routes
- Validates the PLEIADES data structure and API connectivity, as well as the flexibility of the WASTREAM software suite







### **Contact:**

contact@pleiades-platform.eu



http://pleiades-platform.eu



