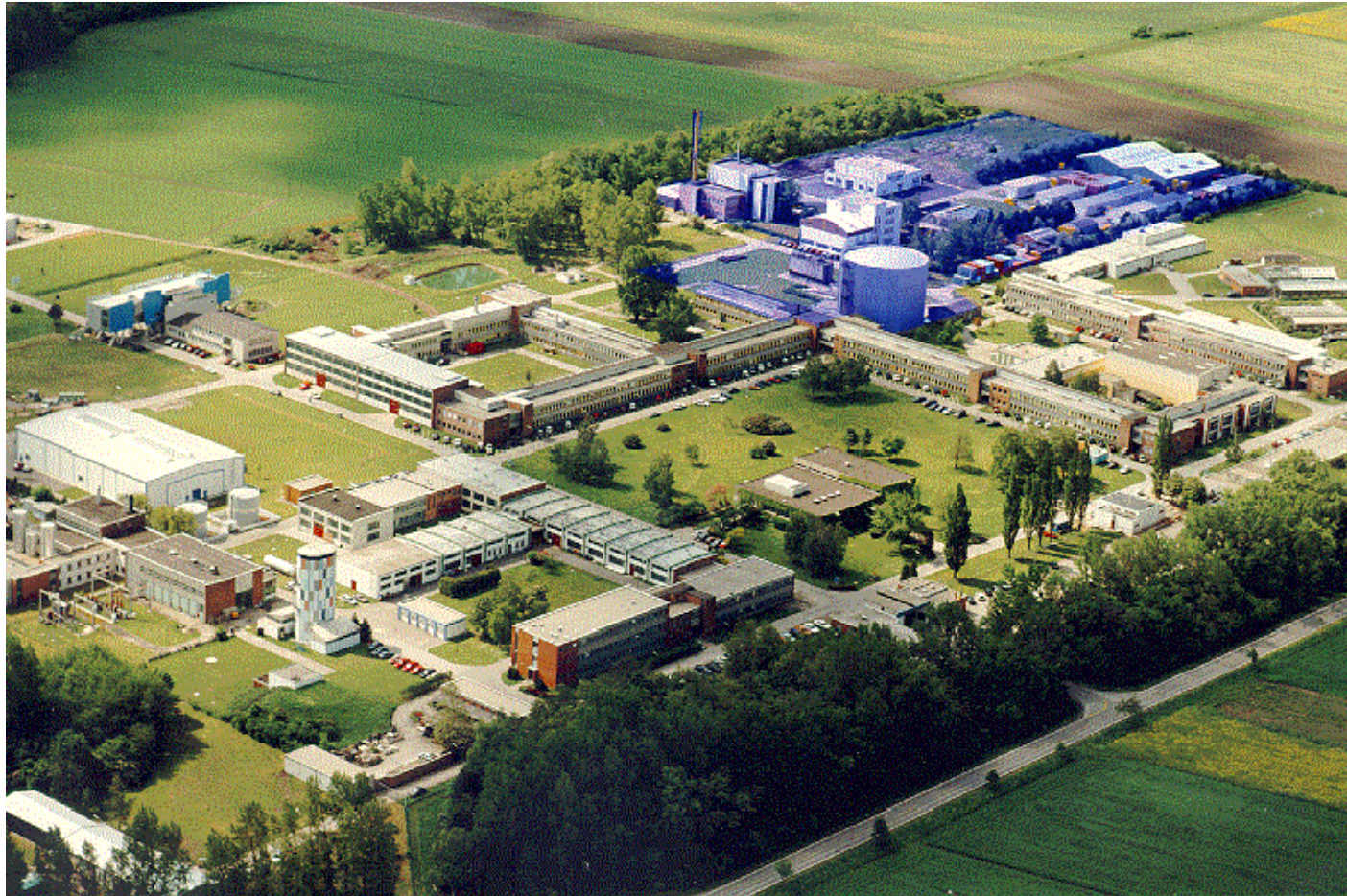


Nuclear Engineering Seibersdorf GmbH - NES

Austrian Research Centers



Activities of NES

Treatment and conditioning of radioactive waste

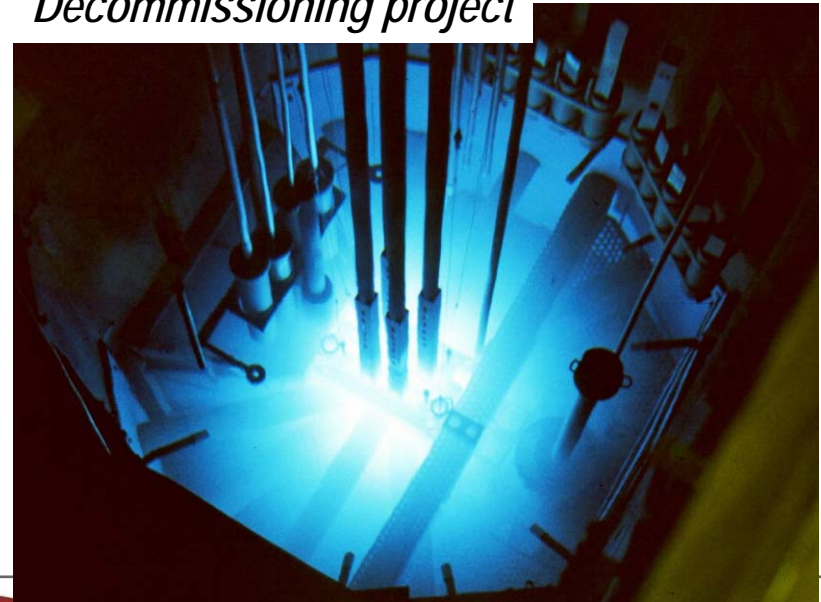


Safe Handling in the Hot Cells Laboratory



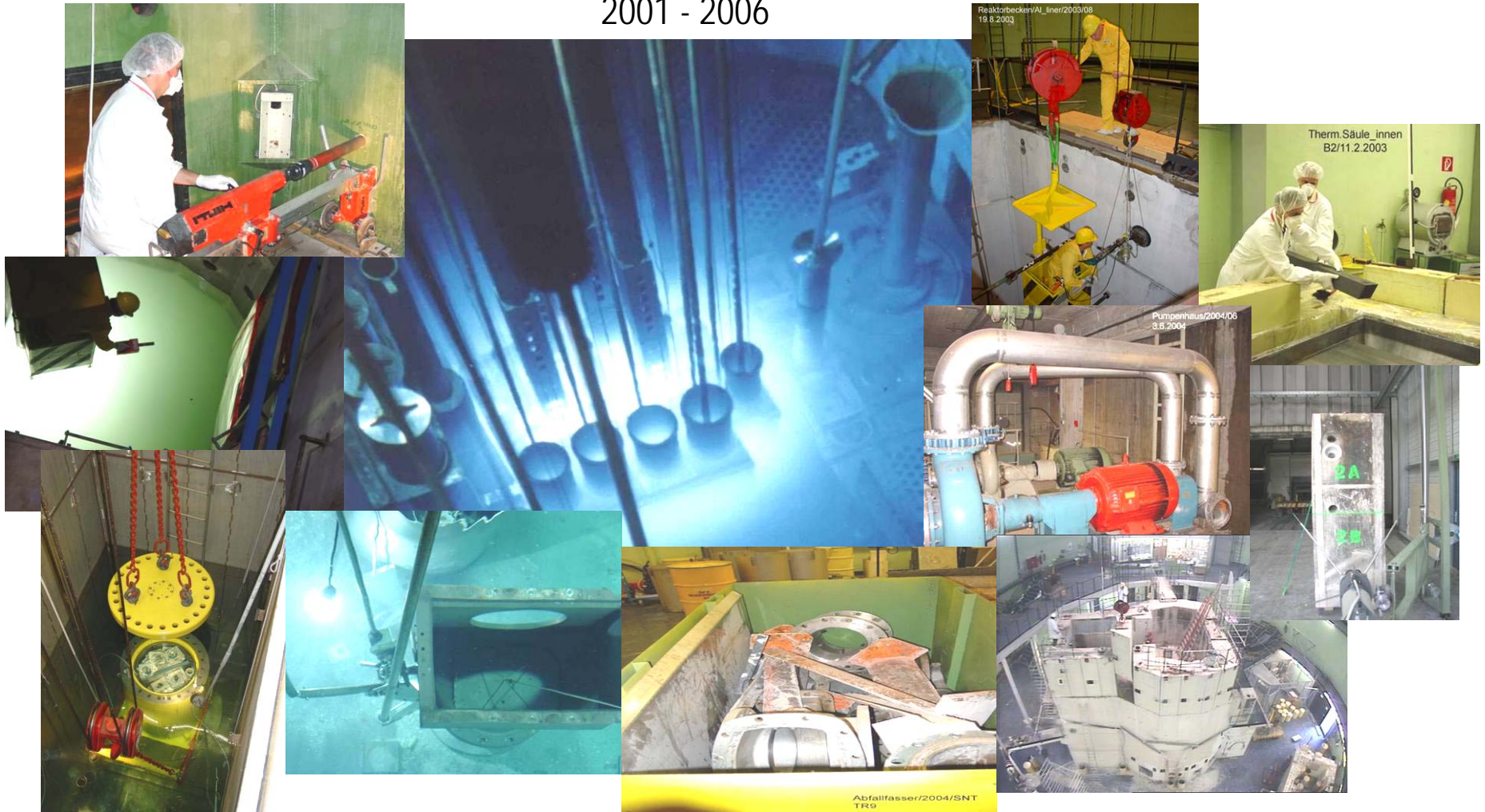
Decommissioning project

Site clean-up measures



Research - Reactor - Decommissioning

2001 - 2006



The ASTRA Reactor – a brief history

- 1955 Foundation of the Österreichische Studiengesellschaft für Atomenergie Ltd - (ÖSGAE)
- 1960 ASTRA Reactor reaches first criticality - testing at 100 W until 1962
- 1982 Substitution of 90%-HEU to 20%-LEU UxSiy-fuel elements completed
- 1984 Reactor power increased to 9 MW, finally to a max. of 10 MW thermal
- 1999 Last operation of the ASTRA Reactor, shut down and start of decommissioning with January 2000



W. M. Molotow, Ambassador to IAEA
M. J. Hignatsberger, FZ-Seibersdorf
29. September 1960

The ASTRA Reactor – the way to permanent shut down

1978 – public referendum generally rejecting the use of nuclear power in Austria

Scientific use of the ASTRA reactor is subsequently decreasing. Extended commercial possibilities (radiopharmaceuticals, sources for industrial and medical application, NTD-silicon doping) cover hardly more than 50% of the reactors operational costs.

1994 – preliminary shut down concept by reactor management on behalf of government audit office

Return of spent fuel 1998 at the earliest (assuming US-DOE continues recovering program), 50 to 100 tons of activated and contaminated materials to be expected. 25 years of manpower and total costs of approx. 2.4 M-Euro.

1996 – US-DOE resumes recovering program for fuels of research reactors (suspended since 1988)

1997 – new management of the ASTRA decides for an earliest possible shut down for financial and political reasons

1998 to 1999 – comprehensive decommissioning study on behalf of the Austrian government

First possible shipping date for the actual 54 spent fuel elements established with US-DOE in late 2000. 160 tons of activated and contaminated materials to be expected. 90 years of manpower and total costs of 13 M-Euro now including the conditioning of LLW, clearance of the buildings, radiation protection measures and legal and technical documentation.

ASTRA Reactor Decommissioning – planning, financing, legal requirements

Planning: based on the comprehensive decommissioning study from 1999

Phase 0 – removal of the spent fuel elements to US-DOE Savannah River Plant till the end of 2000

Phase 1 – removal of the intermediate level waste (ILW) until middle of 2002

Phase 2 – removal of low level waste to be finished till the middle of 2005

Phase 3 – clearing of the buildings till the end of 2005

Finances: based again on the comprehensive decommissioning study from 1999

In November 1999 the project was finally presented to the legislation and duly legalized. The financial covering of the estimated 13 M-Euro divided into six equal parts over the years 2000 to 2005 was granted. The formal guarantee was extended late in December 1999. Work on phase 0 started with January 2000.

**Austrian legislation: – operation of nuclear facilities under federal supervision
– decommissioning of nuclear facilities under competent local government**

Return of HLW (fuel elements) to US Department of Energy and removal and conditioning of ILW on site was performed under operational license (phase 0 and phase 1). Following a positive statement according Article 37, EURATOM (December 2001) an Environmental Impact Assessment (EIA) was initiated in 2002 - a license to decommission was granted - removal of LLW started in 2003 to be followed by extensive clearance measurements until 2005 (phase 2 and phase 3).

ASTRA Reactor Decommissioning – main tasks

Phase 0 – removal and ultimate disposal of the fuel elements

Phase 1 – recovering and treatment of ILW

recovering and treatment of ILW from the vicinity of the core
handling and conditioning of neutron exposed graphite

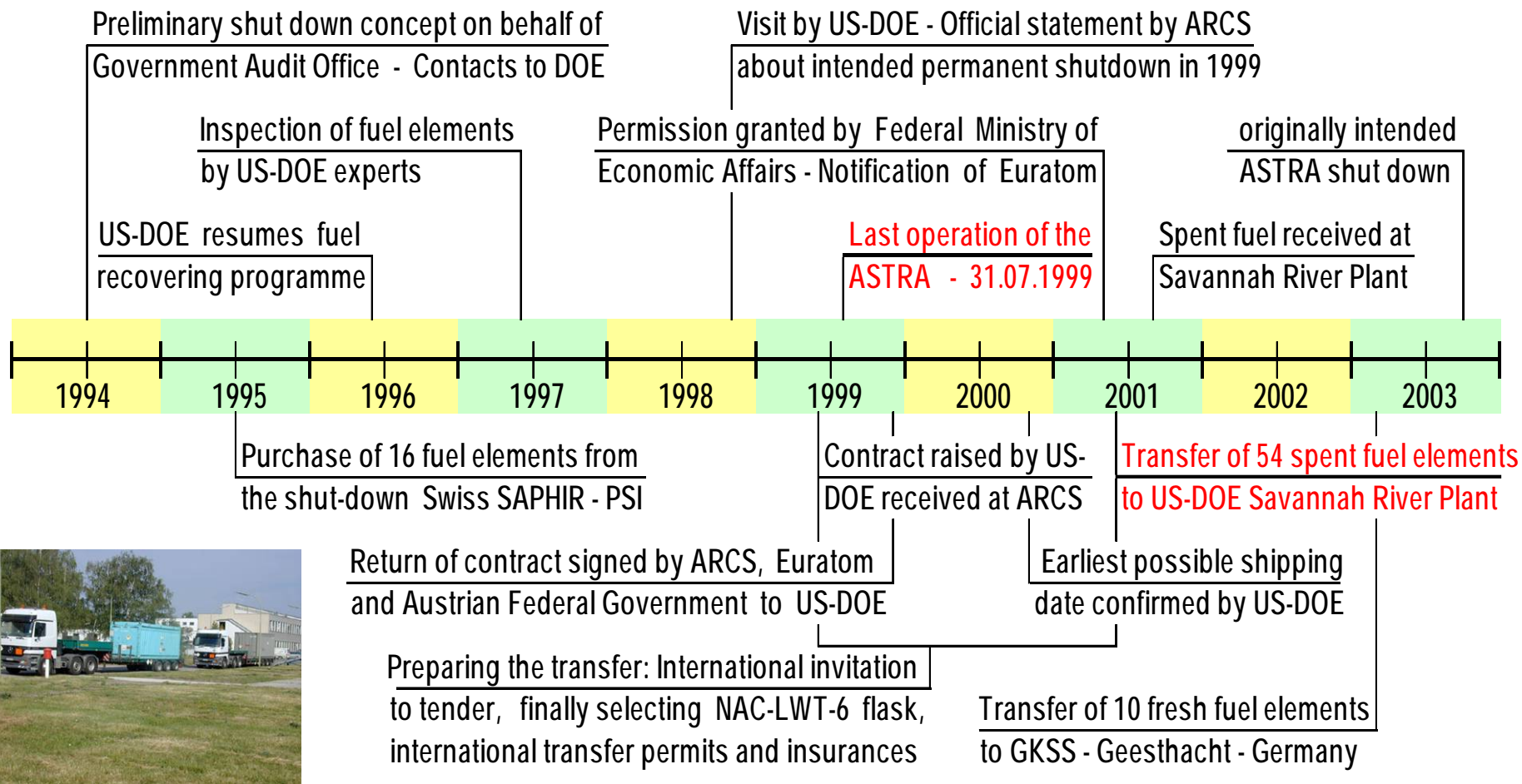
Phase 2 – Recovering and treatment of LLW

Environmental Impact Assessment (EIA)
“fingerprinting” contamination of the primary water systems
processing of contaminated and activated metals
“fingerprinting” activation of Barite concrete
dismantling of the biological shield
dismantling of the ventilation systems



Phase 3 – radiological clearance of the surface of the buildings

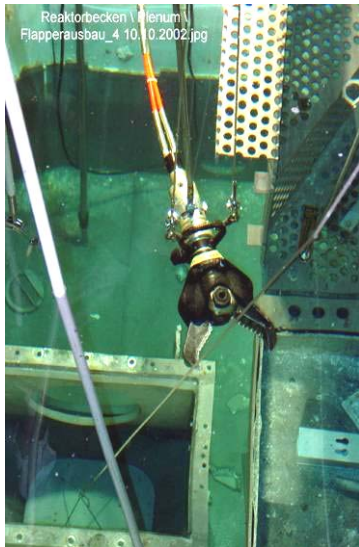
Phase 0 – Disposal of spent fuel elements



Phase 1 – Removal of intermediate level components

2032 kg ILW (+ approx. 1000 kg inactive packing and shielding) conditioned into 5 Mosaik containers, 55 tons LLW preconditioned and transferred to RWMD and 140 tons inactively released.

Total materials removed during phase 1: 198 tons



Working under water with adapted hydraulic pliers



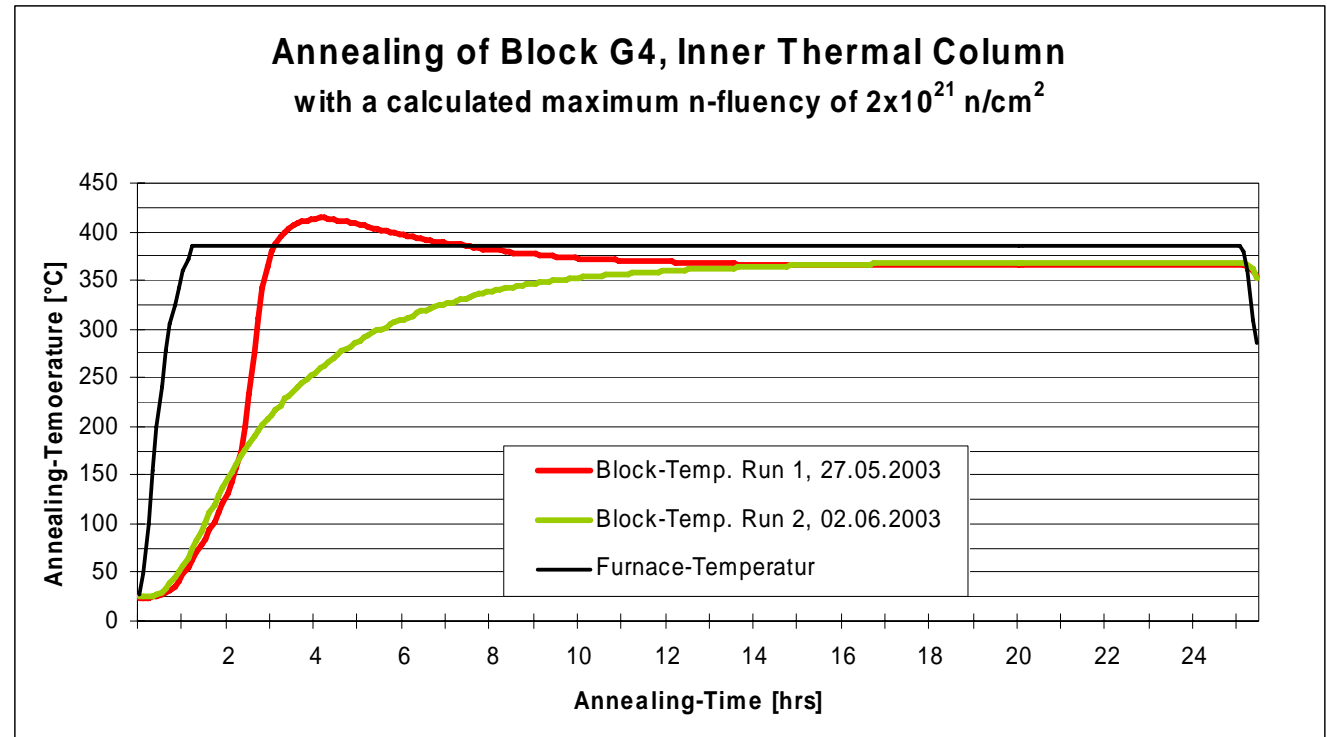
Under water loading of Mosaik Container 1811
Activity contents 370 GBq Co-60



Development of specialized tools

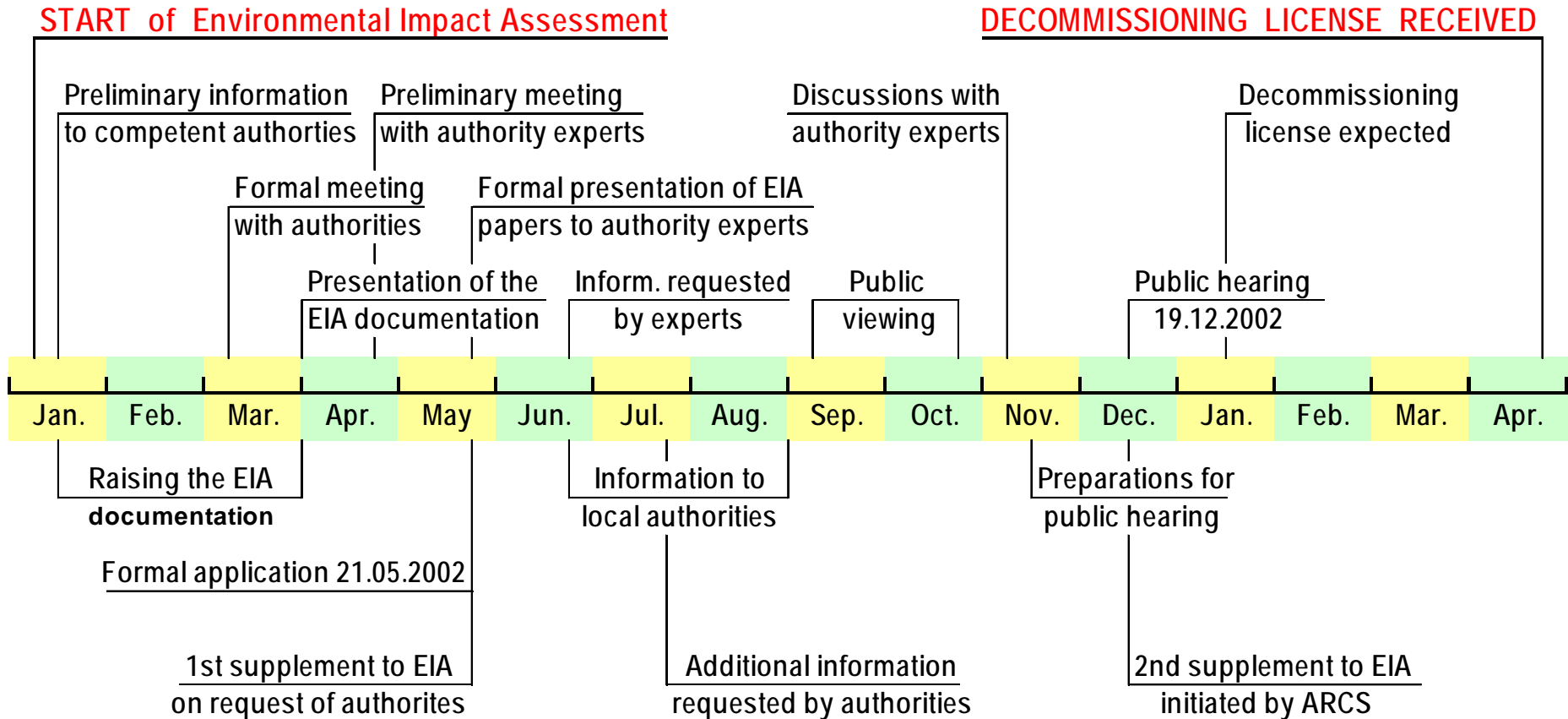
Phase 1 - Conditioning of Reactor Graphite

Preheating of graphites with neutron-doses $>10^{19}$ n/cm², annealing of Wigner*) lattice defects at a temperature of 350°C, (effectiveness $>95\%$)

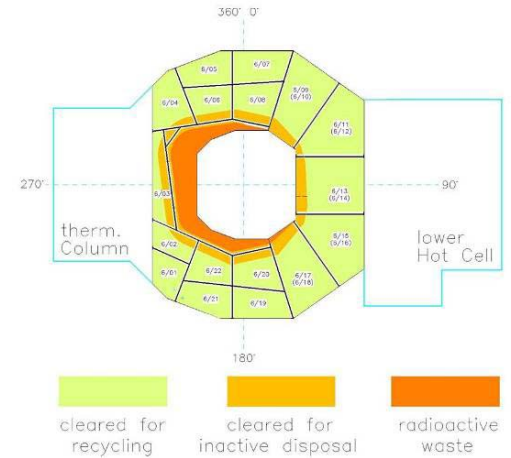


*) Due to lattice defects imposed by long term exposure to fast neutrons at low temperatures, certain materials can contain energies exceeding their specific heat – danger of self ignition - Windscale accident 1957 – recommended for graphite: annealing at temperatures above 250°.

Phase 2 - Environmental Impact Assessment



Phase 2 - Dismantling of the Biological Shield



Phase 3 - Reactor Building: Radiological Clearance of Surfaces

- Entire inside surface of building
(2500 m³ of remaining structures and floors)
- Using available ISOCS at required sensitivity too time consuming
(15 minutes per 1 m², amounting to 600 hours of measuring time)
- Decision to use large-area contamination monitors
(1 minute per m², measuring time calculated 40 hours)
- Threshold values defined at 25% of calculated values
based on established nuclide vector



Summarizing the Decommissioning of the ASTRA-Reactor

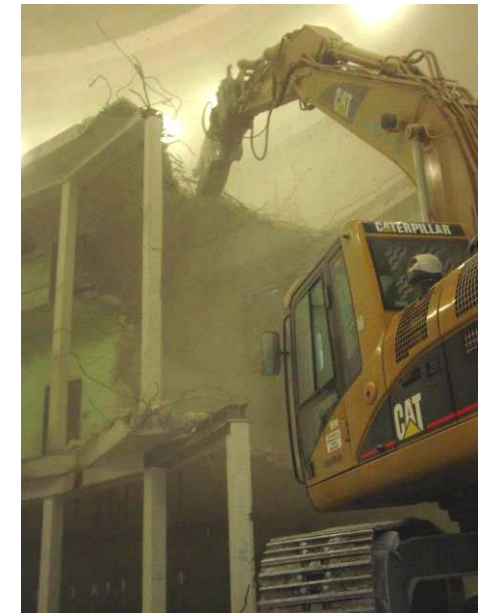
- Timetable
- Materials Management
- Cost Analysis
- Radiological Protection



ASTRA-Reactor Decommissioning – Materials Management

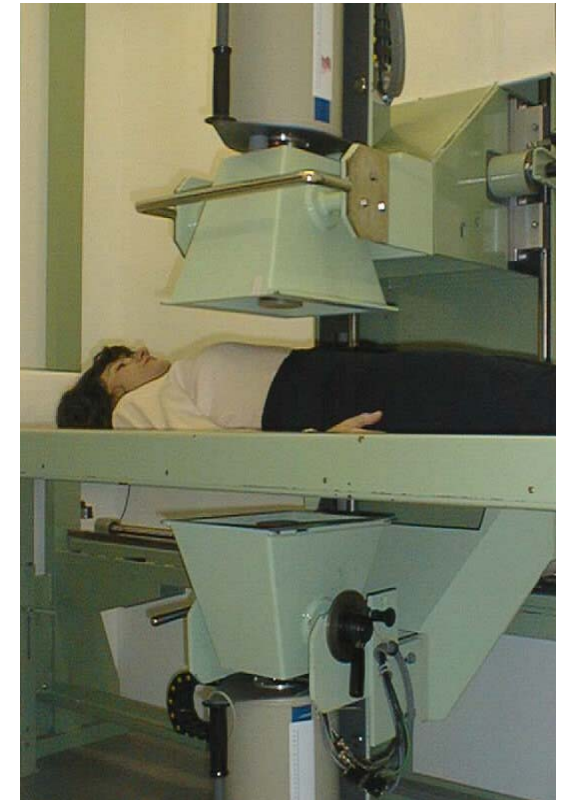
Total Mass, remaining structures within cleared reactor building included	
198 t	active/inactive, dismantling of reactor components (work in phase 1 under operating license)
1592 t	active/inactive, dismantling the biological shield (work in phase 2 under decommissioning license)
384 t	inactive, unrestricted, dismantling remaining structures within cleared reactor building (Oct. to Dec. 2006)
2174 t	total

Total Mass removed until 31.12.2006, Ways of Disposal		
3 t	ILW, intermediate level radioactive waste, NES interim storage	0,1 %
80 t	LLW, low level radioactive waste, NES interim storage	3,7 %
144 t	materials into conventional mass-dump	6,6 %
1947 t	materials for unrestricted re-use	89,6 %
2174 t	total	100,0 %



ASTRA-Reactor Decommissioning – Radiological Protection

Company	Labour [years]	Maximum Permissible Dose [mSv]	Internal/External Dose Encountered [mSv]	Dose relative [%]
NES	66.8	1337	75.8	5.7
Subcontractors	13.3	269	9.8	3.6
TOTAL	80.1	1606	85.6	5.3



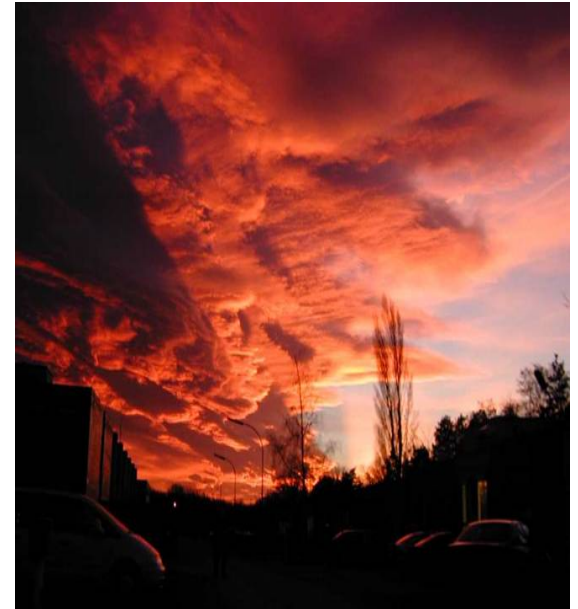
ASTRA-Reactor Decommissioning – Cost Analysis

EURO

NES-Labour (66.8 years of labour)	5.244.420	34.5%
Subcontractors (13.3 years of labour, specialists, experts, diamond-wire equipment etc.)	2.322.810	15.3%
Materials	703.500	4.6%
Conditioning in NES Intermediate-Storage	2.790.620	18.3%
Conditioning in NES Hot-Cell-Laboratory	1.009.220	6.6%
Common Costs, Administration, Rents a.s.o.	2.549.250	16.7%
Further Costs (transport, insurances, travelling)	602.870	4.0%
Total	15.222.690	100%

ASTRA-Reactor Decommissioning - Conclusion

Finally it can be manifested, that the dismantling of the ASTRA-reactor in the 50th year after the founding of the Austrian Research Center Seibersdorf was performed within the given limits in time and financial resources, under strict observation of the legal and radiological requirements and without any incidents, neither in the sense of personal safety nor in radiological hazards to the environment .



Thank you for your Attention