Australian Government

Australian Nuclear Science and Technology Organisation

OPAL Decommissioning

Design Considerations

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- General Overview of OPAL Structure
- OPAL Decommissioning at Design Stage
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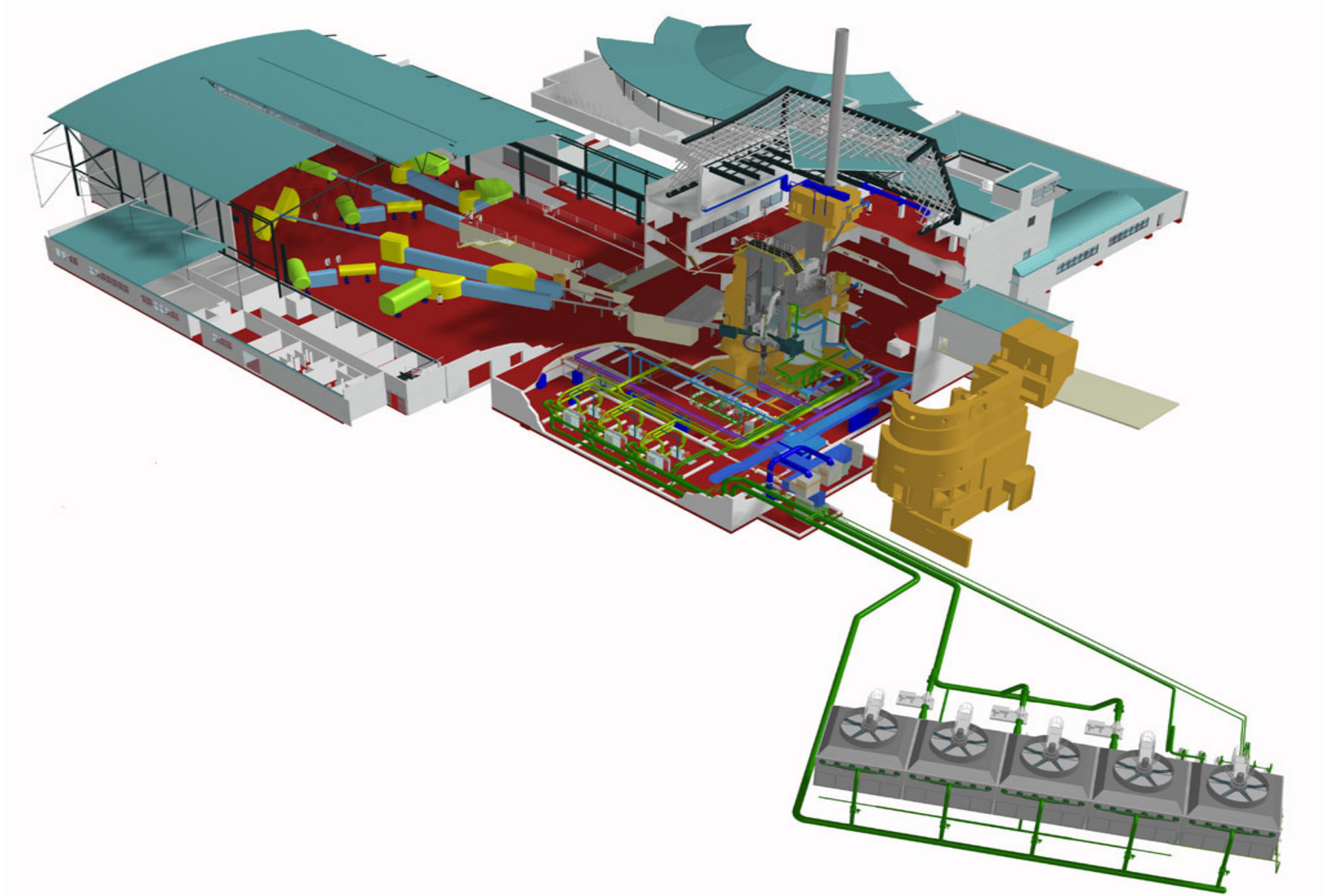
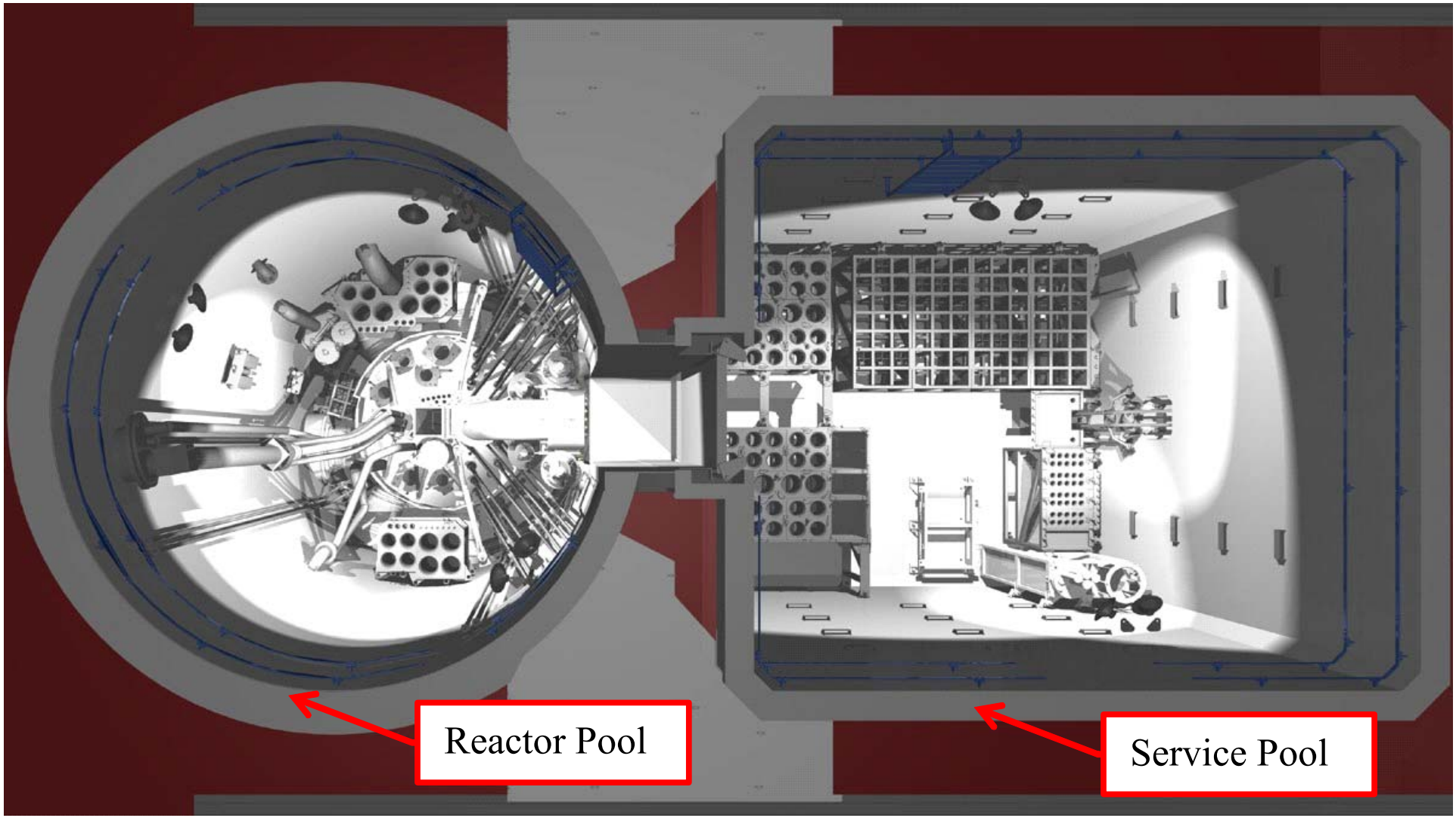
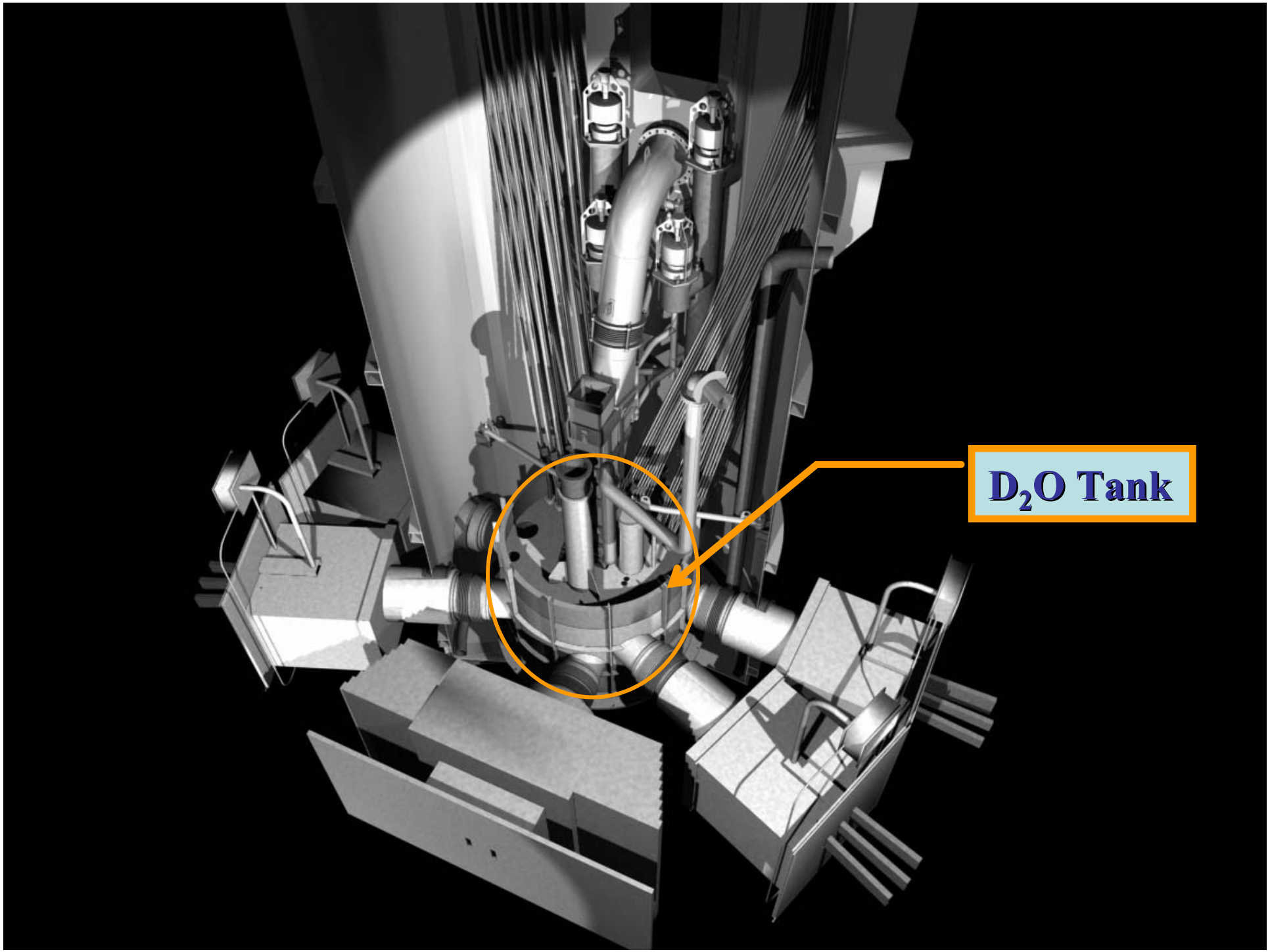
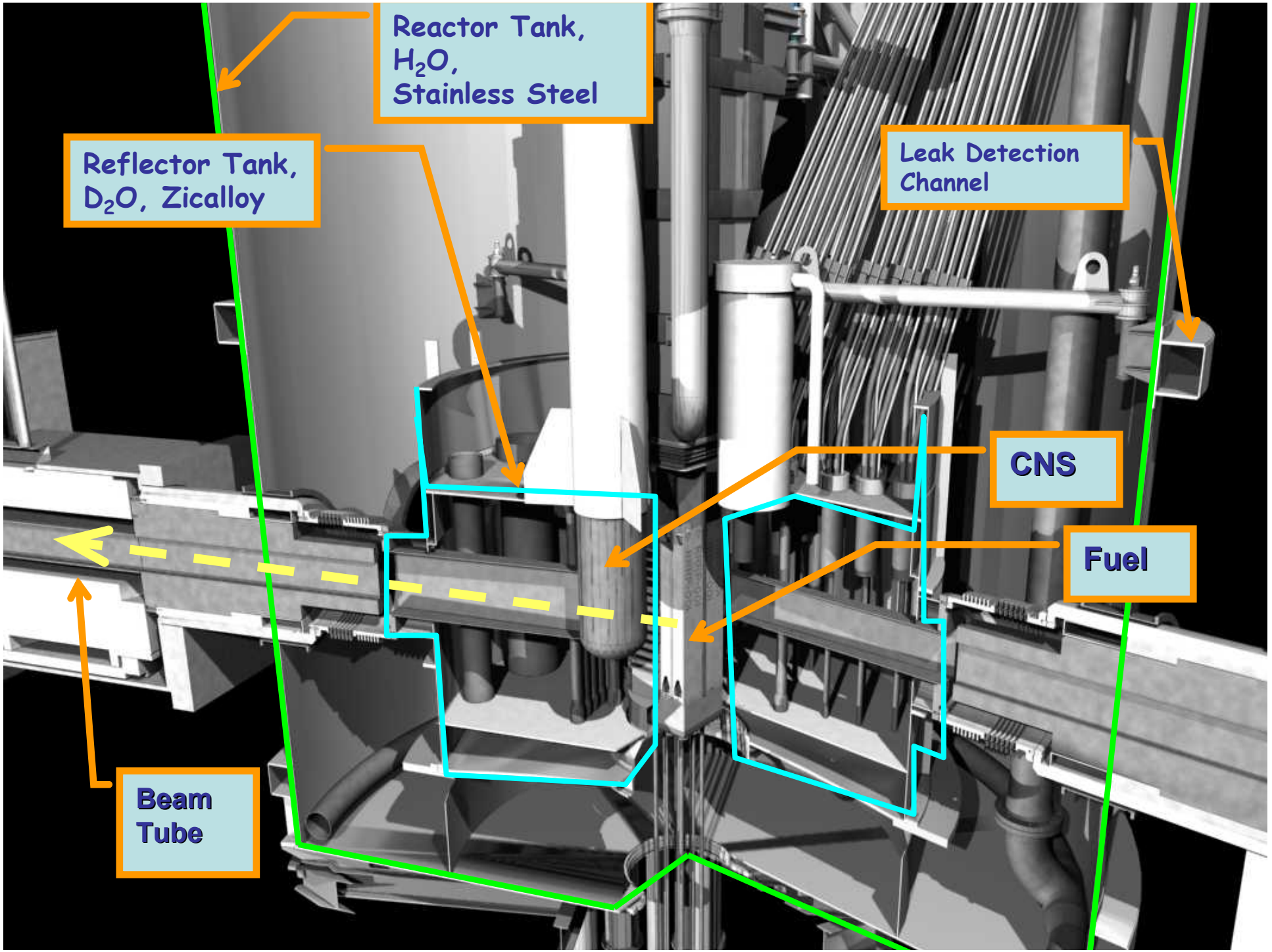



Reactor Pool
Service Pool


D_2O Tank


Reactor Tank,
H_2O,
Stainless Steel
Reflector Tank,
D_2O, Zicalloy
Leak Detection
Channel
CNS
Fuel
Beam
Tube

Built for Decommissioning

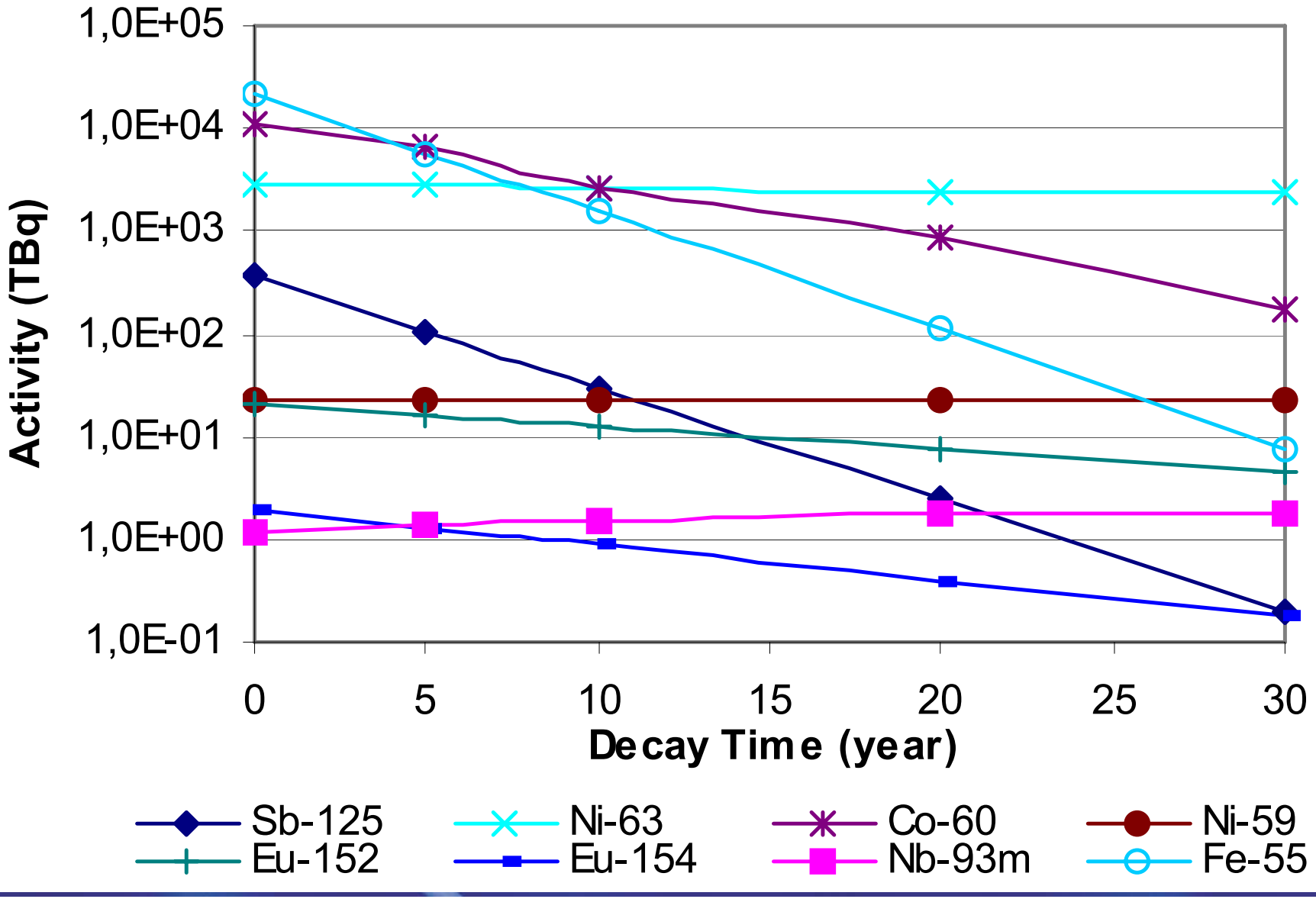
- 'Chapter 19' - Decommissioning
  - Part of OPAL Tender Specification
  - Based on lessons learnt from Moata/HIFAR and other overseas decommissioning examples
  - IAEA recommendations
- Dedicated System Level Coordinator
  - Independent to other OPAL System review team
- World's first?
  - Plan Funeral before Birth: Complete Life-cycle.

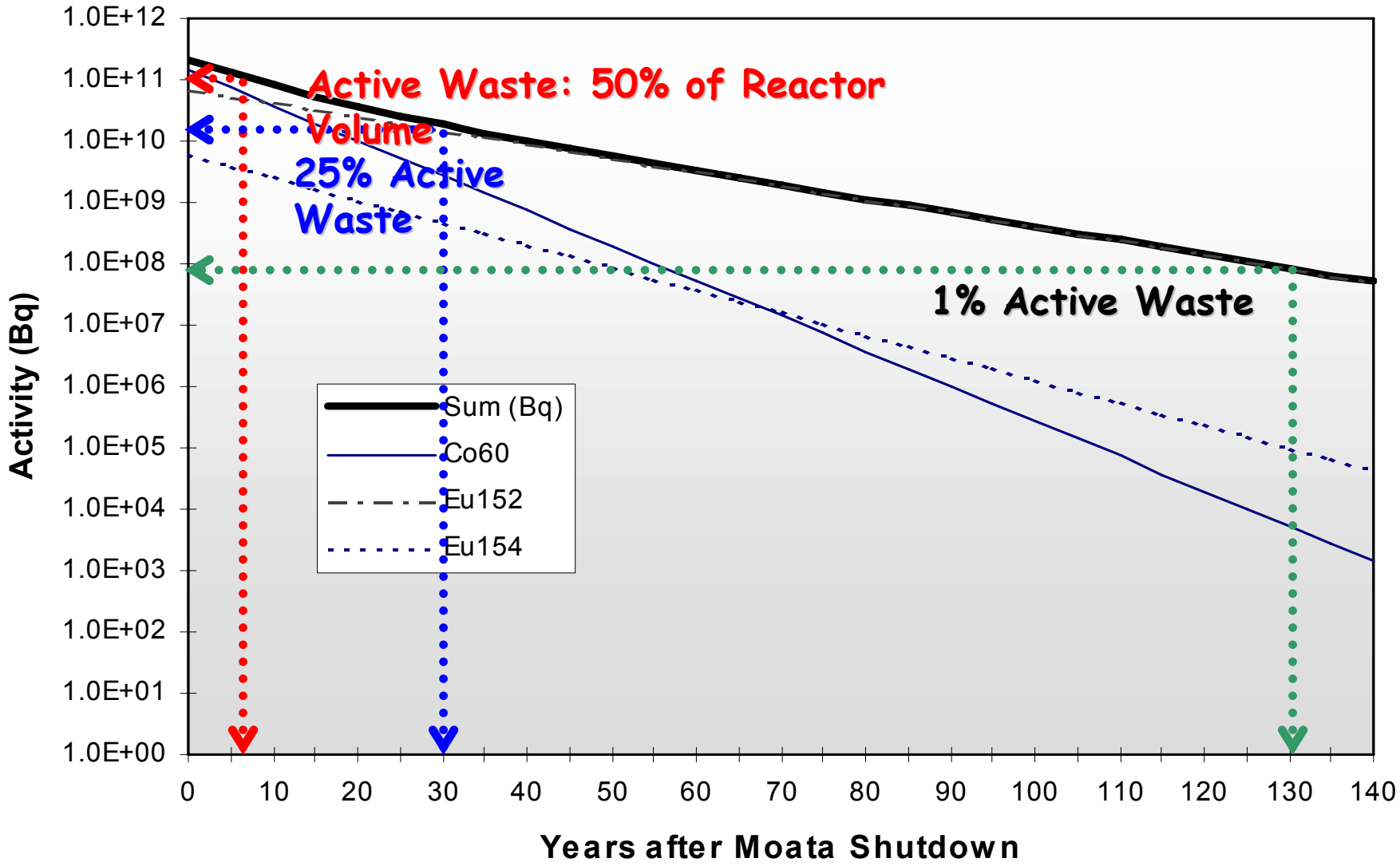
Nuclide	Half-life	Decay Mode/Major radiation	Target
^{24}Na	15 h	β^- / γ	Aluminium
^{27}Mg	9.5 m	β^- / γ	Aluminium
^{28}Al	2.2 m	β^- / γ	Aluminium
^{45}Ca	163 d	β^- / β^-	Concrete
^{51}Cr	27.7 d	Є / γ	SS 304, Aluminium
^{54}Mn	312 d	Є / γ	SS 304
^{55}Fe	2.7 y	Є /	SS 304, Concrete
^{56}Mn	2.6 h	β^- / γ	SS 304, Aluminium
^{59}Fe	44.5 d	β^- / γ	SS 304, Concrete
^{59}Ni	76 y	Є / λ	SS 304
^{60}Co	5.3 y	$\beta^- / \beta^-, \gamma$	SS 304, Zircaloy 4, Concrete, Steel
^{63}Ni	100 y	β^- / β^-	SS 304, Zircaloy 4
^{65}Zn	244 d	Є, β^+ / γ	Aluminium
^{93m}Nb	13.1 y	/ γ	Zircaloy 4
^{93}Zr	1.5 10^6 y	β^- / β^-	Zircaloy 4
^{95}Nb	35 d	β^- / γ	Zircaloy 4
^{95}Zr	64 d	β^- / γ	Zircaloy 4
^{97}Nb	72 min	β^- / γ	Zircaloy 4
^{97}Zr	16.8 h	β^- / γ	Zircaloy 4
^{108m}Ag	418 y	Є / γ	Ag-In-Cd alloy
^{109}Cd	463 d	Є / β^+	Ag-In-Cd alloy
^{110m}Ag	250 d	β^- / γ	Ag-In-Cd alloy
^{125m}Te	57.4 d	/ γ	Zircaloy 4
^{125}Sb	2.77 a	β^- / γ	Zircaloy 4
^{152}Eu	13.3 y	Є, β^+, β^- / γ	SS 304, Concrete, Steel
^{154}Eu	8.8 y	β^- / γ	SS 304, Concrete, Steel
^{205}Pb	1.5 10^7 y	Є / β^+	Lead

Є= Electron Capture
β+= Positron
β-= Beta Particle
γ = Gamma-ray

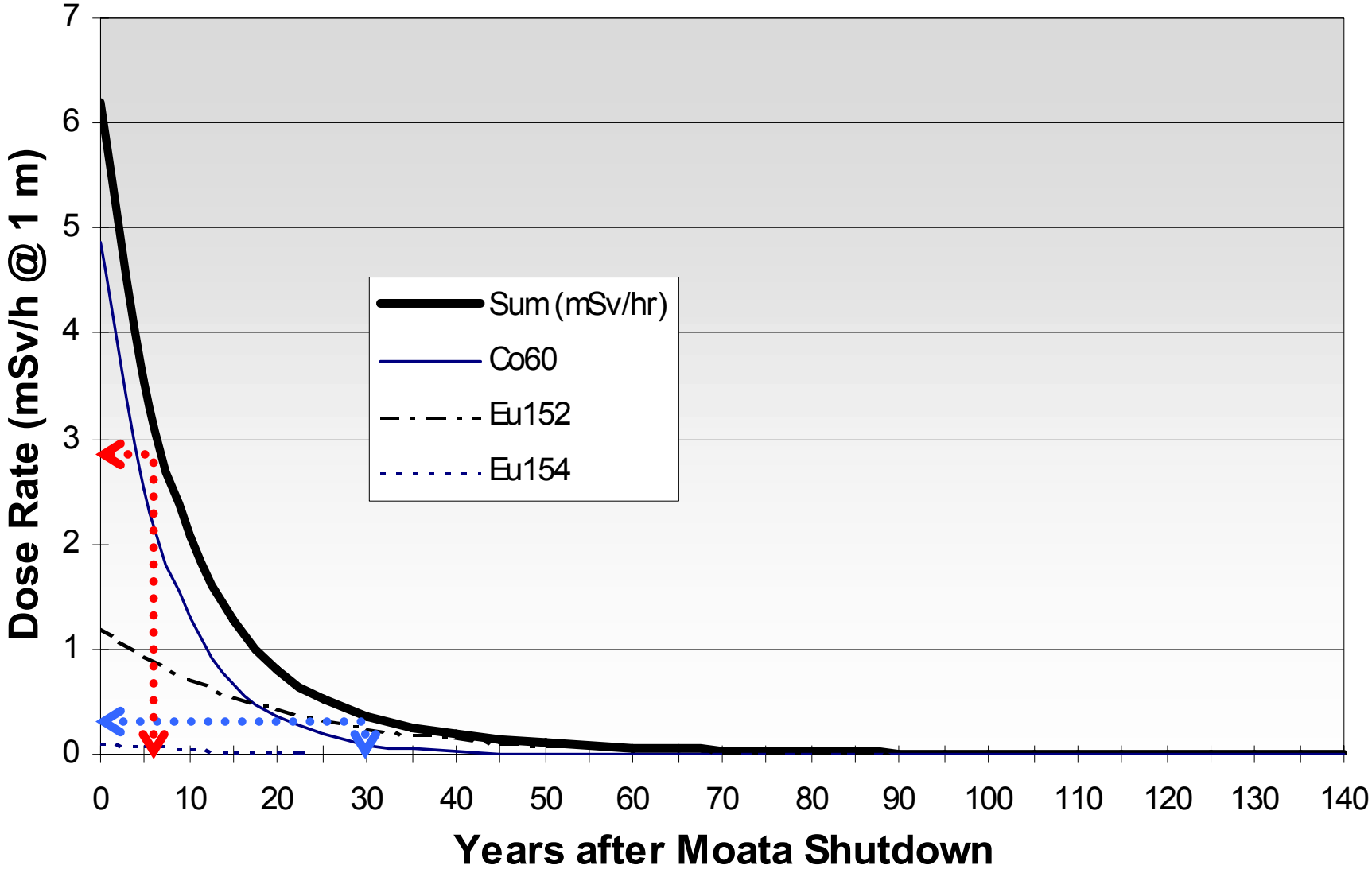
Table 19.4/1 Radionuclides Included for Activity Estimation
After 40 years of normal operation at full power

Figure 19.4/1 Activity of the Dominant Radioactive Inventory





Example: Decay of Main Nuclides of Moata



Example: Dose Rate from Moata

Waste Classification

- Exempt Waste (Free Release)
  - Annual dose to public less than 0.01 mSv
  - IAEA Safety Series No. 111-G-1.1 Classification of Radioactive Waste (1994)
- LLW and ILW:
  - higher than 0.01 mSv/yr
  - less than 2 kW/m^3 thermal
  - Short lived: < 400 Bq/g total package
  - Long lived: > 400 Bq/g
- HLW: Not from OPAL

Material Selection

- Long-lived nuclides are minimised near the core
- Designed for 40 years
  - CNS: 10 years – Flange connection.
- Short decay period

Design Features - Easy Dismantling

- Modular sections
  - No unnecessary cutting
  - Can be unbolted using remote handling tool
- Space for dismantling
  - Accessibility of remote handling tools
  - Manoeuvrability of objects
- Underwater Storage & Cutting Facility
- Pipe design
  - Easy to drain active fluids
- Decontamination
  - No hard-to-access cavities

During Operations

- Operations History
  - Record – normal and abnormal conditions
  - Radioactive inventory list update
- Decommissioning Plan
  - Living Document
  - Update or revise as appropriate
  - Conform to New regulations (IAEA, ARPANSA, etc)
  - New technology in 50+ years time

TAIL-PIECE
What is R2-D2?

- R2-D2 Specification
  - It came from the peaceful world of Naboo.
  - R2-D2 served the elected monarch aboard the Royal Starship.
  - 0.96 m tall
- Skills
  - Arc Welding
  - Buzz Saw
  - Remote Handling
  - Decommissioning Contractor??

The End

Thank you for your attention.

Long Live the OPAL Reactor….

and Happy R.I.P. afterwards

For more information or *feedback*:

- www.ansto.gov.au
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