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# **EPR™ Decommissioning by Design**

Ian R. Terry

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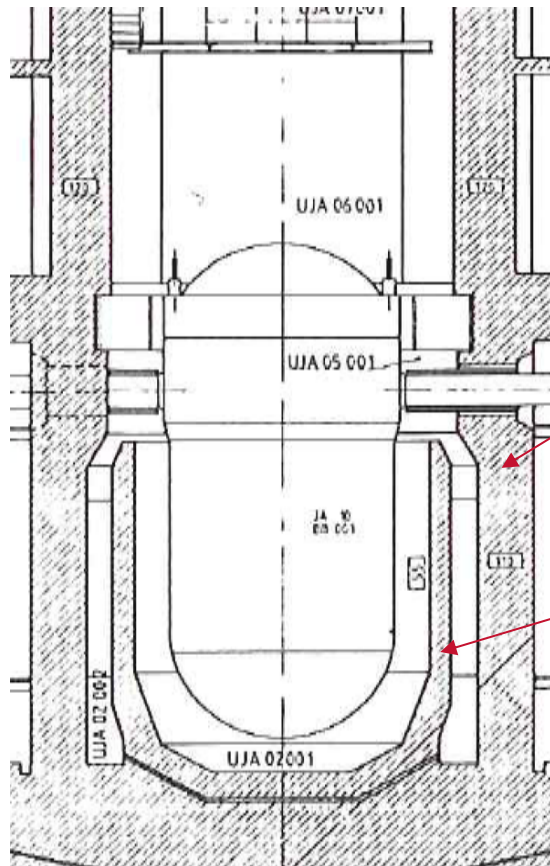
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Cambridge UK, 19<sup>th</sup> November 2010





# EPR™ Decommissioning by design



Load bearing shield

Reactor shield

Decommissioning

KONVOI series

**AREVA NP**



# **EPR™ Decommissioning by design**



**Recommendations of the IAEA in 1997**

**Design and Construction of Nuclear Power Plants to facilitate  
Decommissioning**

**Technical Reports Series no. 382 1997**

**EPR™ Basic Design time period**



# EPR™ Decommissioning by design



European Utility Requirements for LWR nuclear power plants

<http://www.europeanutilityrequirements.org>



# EPR™ Decommissioning by design



**Decommissioning is already today** important in design  
assessment before awarding a construction contract



# **EPR™ Decommissioning by design**

**For consideration:**

- ▶ **Costs**
- ▶ **Strategy**
- ▶ **Radiation protection**
- ▶ **Waste minimisation**
- ▶ **Layout aspects**
- ▶ **Documentation**

**All these points concern either directly or indirectly radiation protection. !**



# **EPR™ Decommissioning by design**

**Documentation:**

**According to IAEA prescription**

- ▶ **Documentation of details during construction of the plant**
- ▶ **Record keeping of irregularities during plant operation**



# EPR™ Decommissioning by design

## Strategy:

- ▶ Immediate dismantling
- ▶ Deferred dismantling



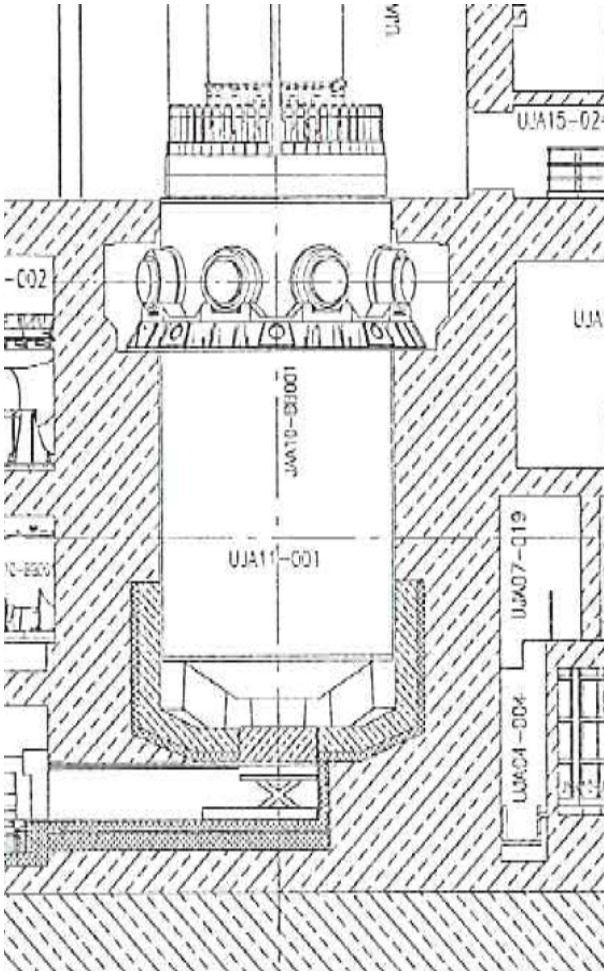
# EPR™ Decommissioning by design

## Costs:

- ▶ With today's design of large commercial plants very little difference between the strategies
- ▶ (Approx. 300 € per installed electrical kW, 2007)
- ▶ Immediate dismantling is politically generally desired
- ▶ Dose (Decont. ?)



# EPR™ Decommissioning by design

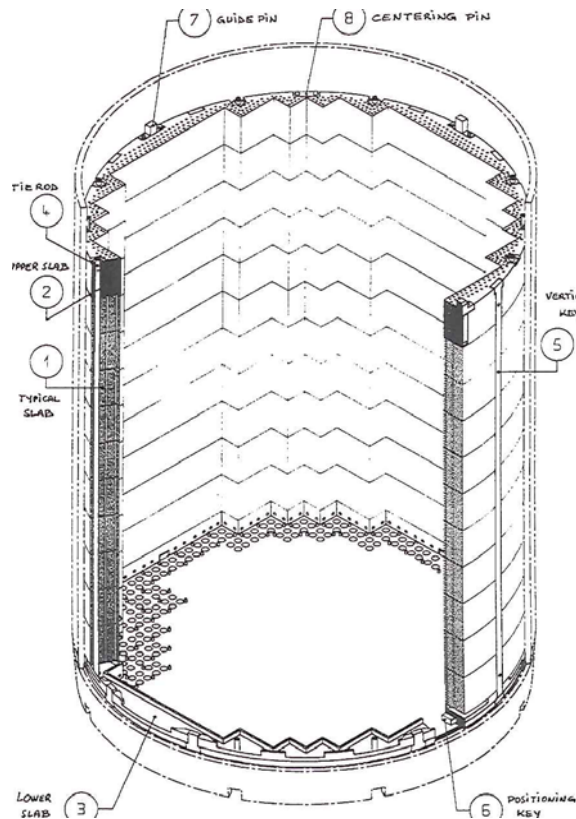


What the EPR™ does not have:

- ▶ A modular reactor shield
- ▶ Instead a monolith structure selected



# EPR™ Decommissioning by design



What the EPR™ does have:

► A neutron shield within the RPV

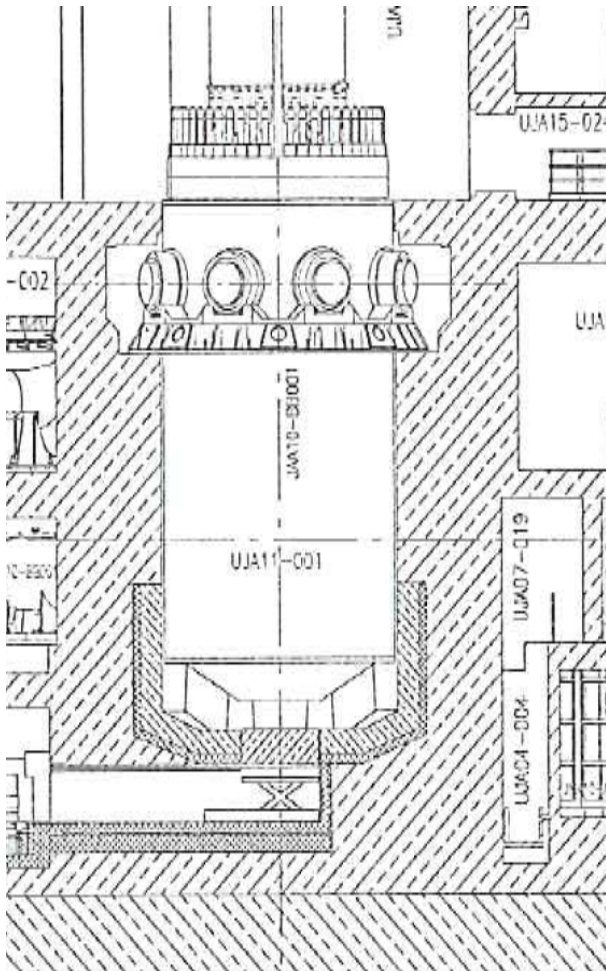
This “Heavy Reflector” is removable in parts

These are moved under water to minimise dose

Serves to minimise the activation in the surrounding concrete



# EPR™ Decommissioning by design



**Inventory in concrete\* (estimate)**

**Some nuclides**

Nuclide	First 50 cm	Whole shield
H3	7E12 Bq	8E12 Bq
Fe55	6E11	7E11
Eu152	1E11	2E11
Total	1.0E13	1.1E13

**\*after 6 years**



# EPR™ Decommissioning by design

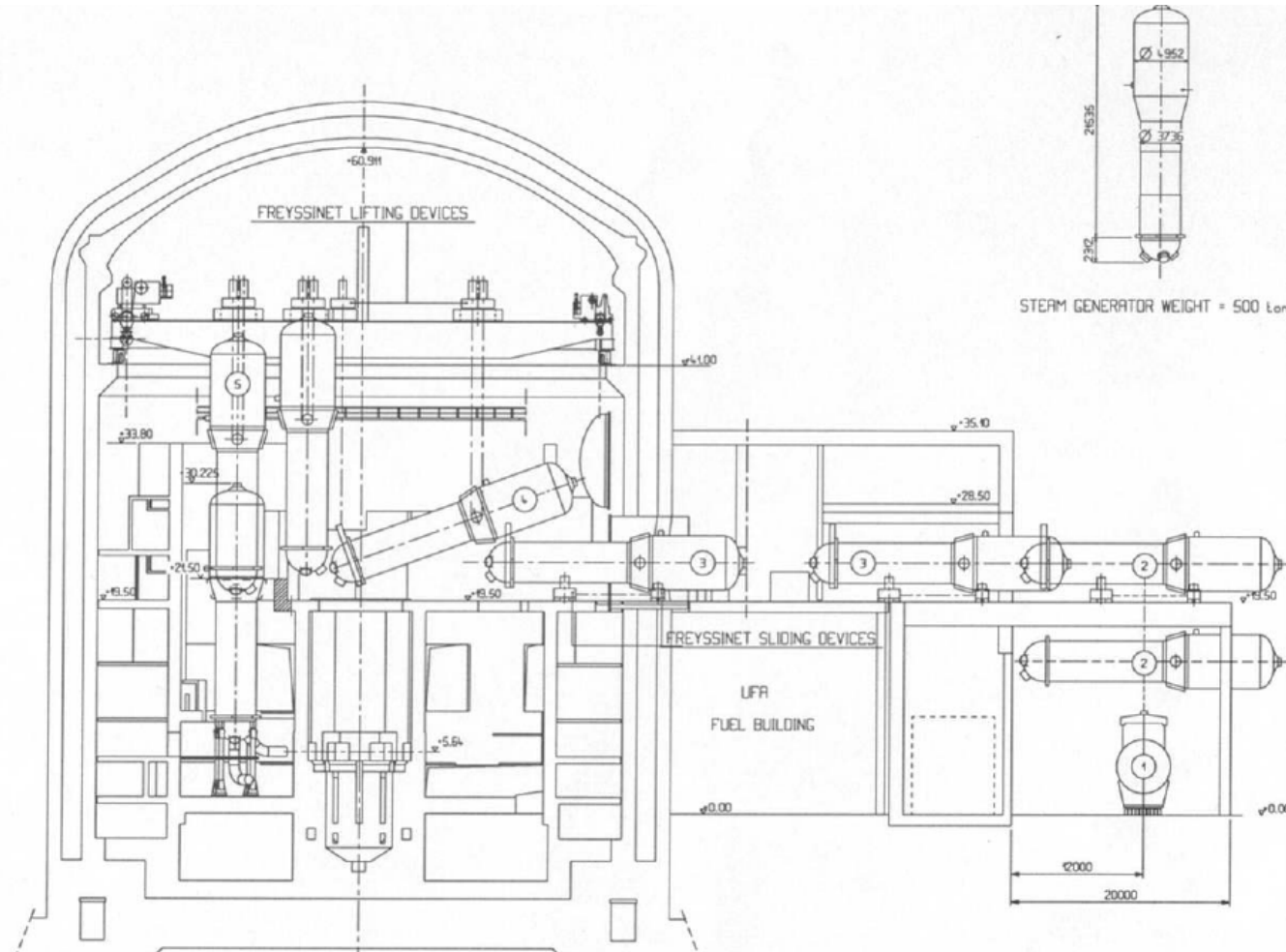
**Design measures for the dismantling  
of large components.**

- ▶ **Steam generators**
- ▶ **Pressuriser**
- ▶ **Reactor pressure vessel**



# EPR™ Decommissioning by design

## Steam generator: Removal in one piece

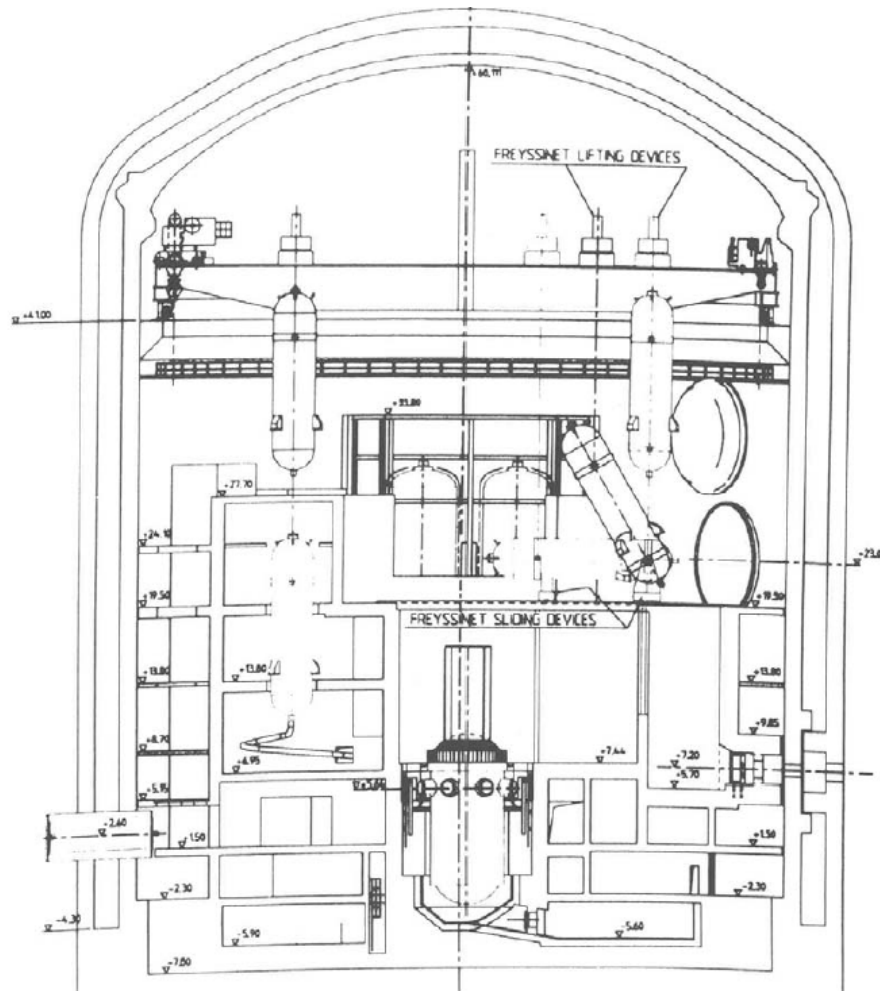


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# EPR™ Decommissioning by design

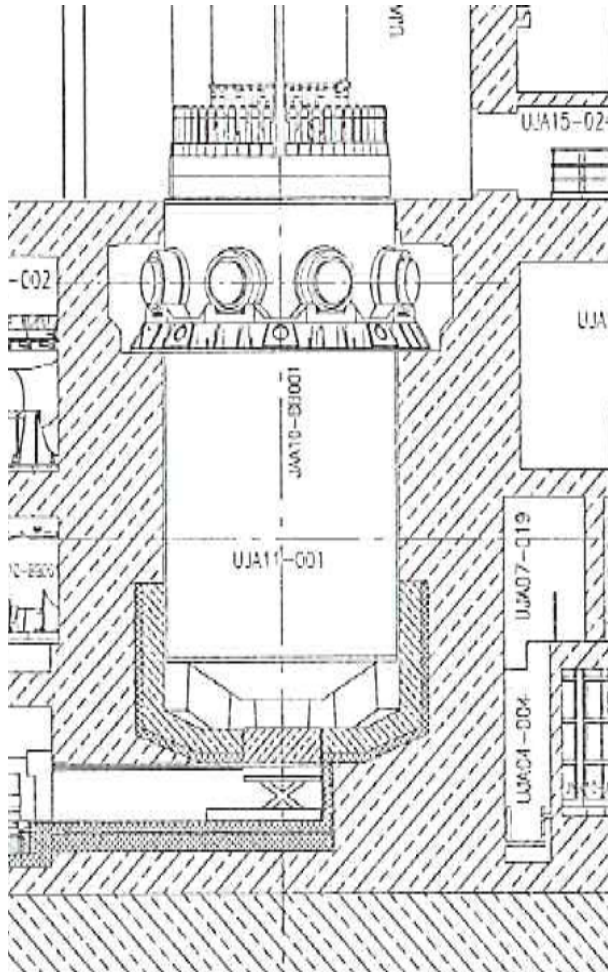
## Pressuriser: removal directly upwards



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# EPR™ Decommissioning by design



## Reactor pressure vessel: alternatives

► Removal in one piece

Or

► Dismantling under water *in situ*



# **EPR™ Decommissioning by design**

## **Material limitation in components**

- ▶ **Reduction in Co59 in steel alloys close to core**
- ▶ **Minimisation of Stellite® in valves**
- ▶ **Avoidance of Ag and Sb in bearings und gaskets**



# EPR™ Decommissioning by design



## Accessibility to large components

- ▶ Clearance always  $> 50$  cm
- ▶ Separation “hot” and “cold”

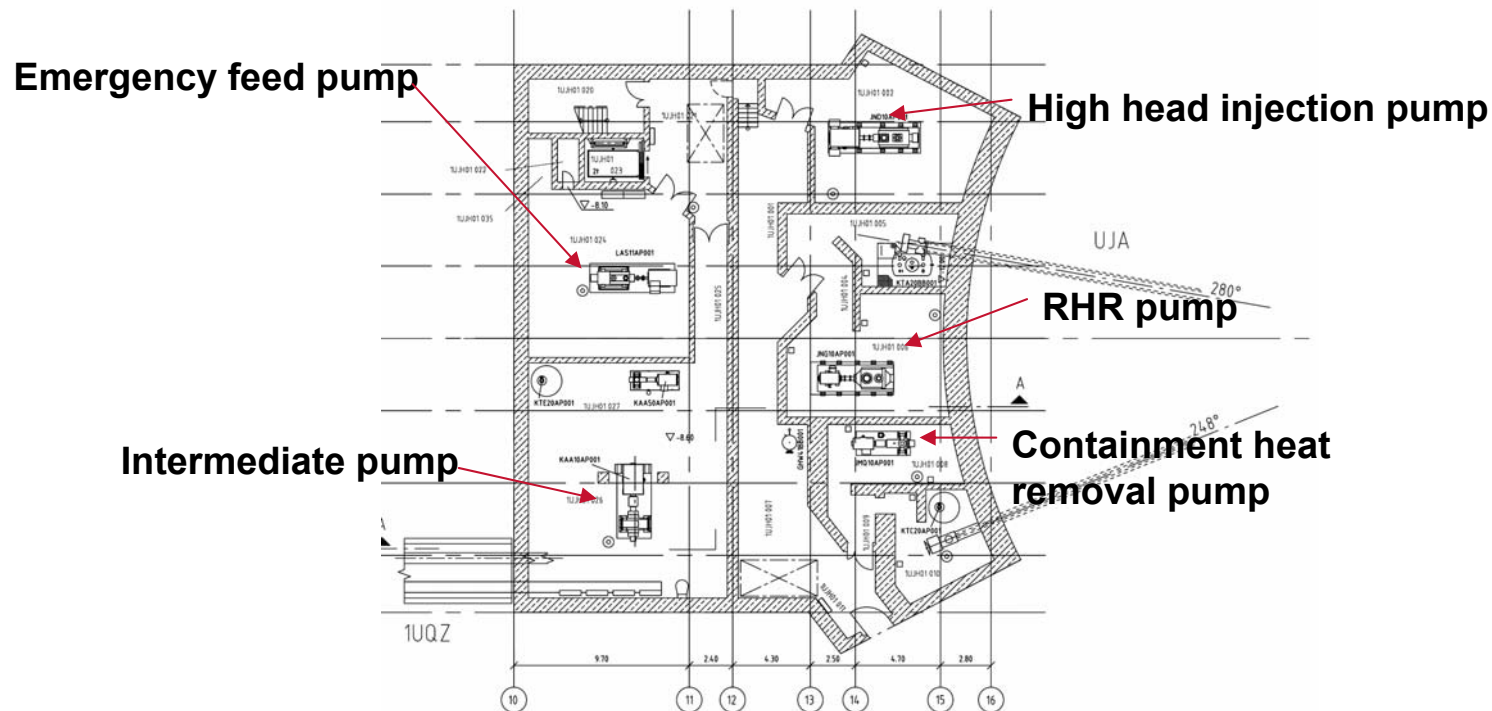
## Time reduction in radiation field



# EPR™ Decommissioning by design



## Accessibility in the Safeguards Building, for example

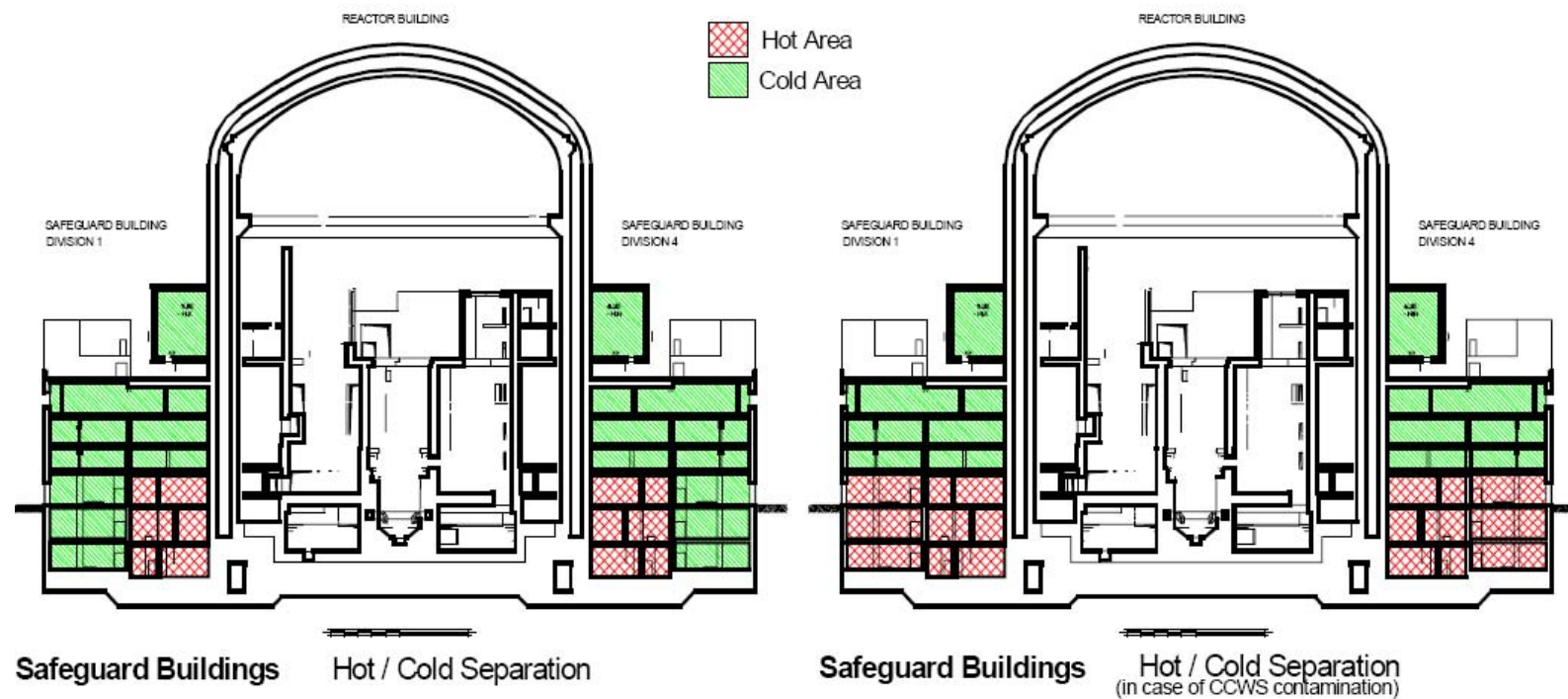


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# EPR™ Decommissioning by design

## Component separation, example 1

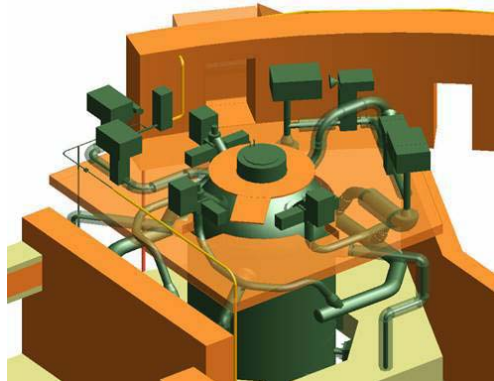




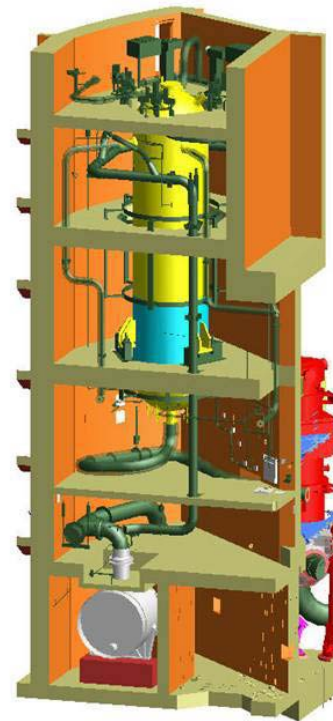
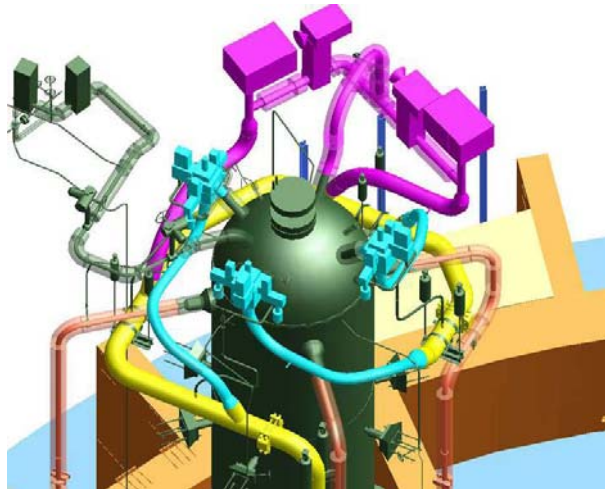
# EPR™ Decommissioning by design



## Component separation, example 2



Access floor to pressuriser discharge valves



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# EPR™ Decommissioning by design

## Waste and Dose

- ▶ **Controlled area approx. 200,000 Tons  
of this about 5,500 Tons in final repository  
( low and intermediate level waste without heat generation)**



# EPR™ Decommissioning by design

Volume :

60 x

Or 20 x 20 x 20 m<sup>3</sup>





# EPR™ Decommissioning by design

**DOSE ???**

- ▶ **Choice of Strategy**
- ▶ **Decommissioning plan**

**however 2 Sv attainable**



# EPR™ Decommissioning by design

The EPR™ design is already suited to decommissioning



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# EPR™ Decommissioning by design

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# **End of presentation**

# **EPR™ Decommissioning by Design**

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