



A BUSINESS OPERATIONS & DECOMMISSIONING
STRATEGY FOR IMPERIAL COLLEGE LONDON
RESEARCH REACTOR 'CONSORT' - A FINANCIAL
RISK MANAGEMENT APPROACH

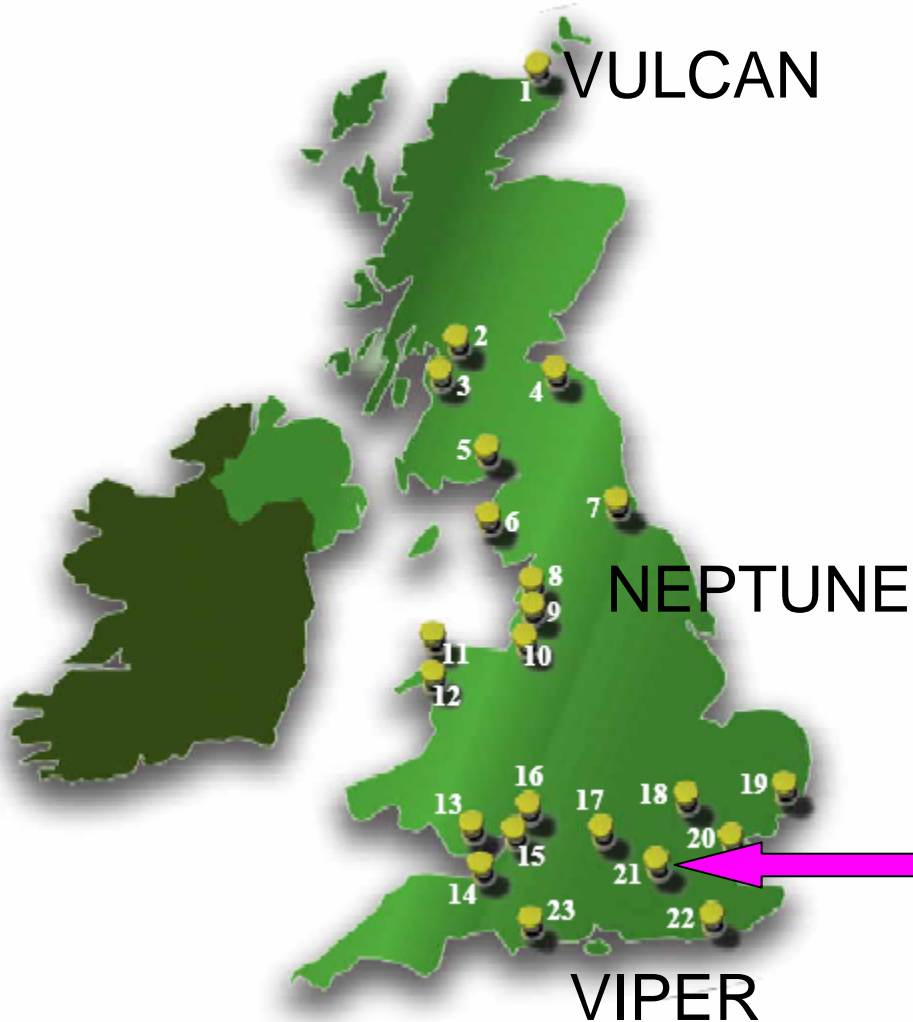
RRFM 11 April 2005

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Where Are We?

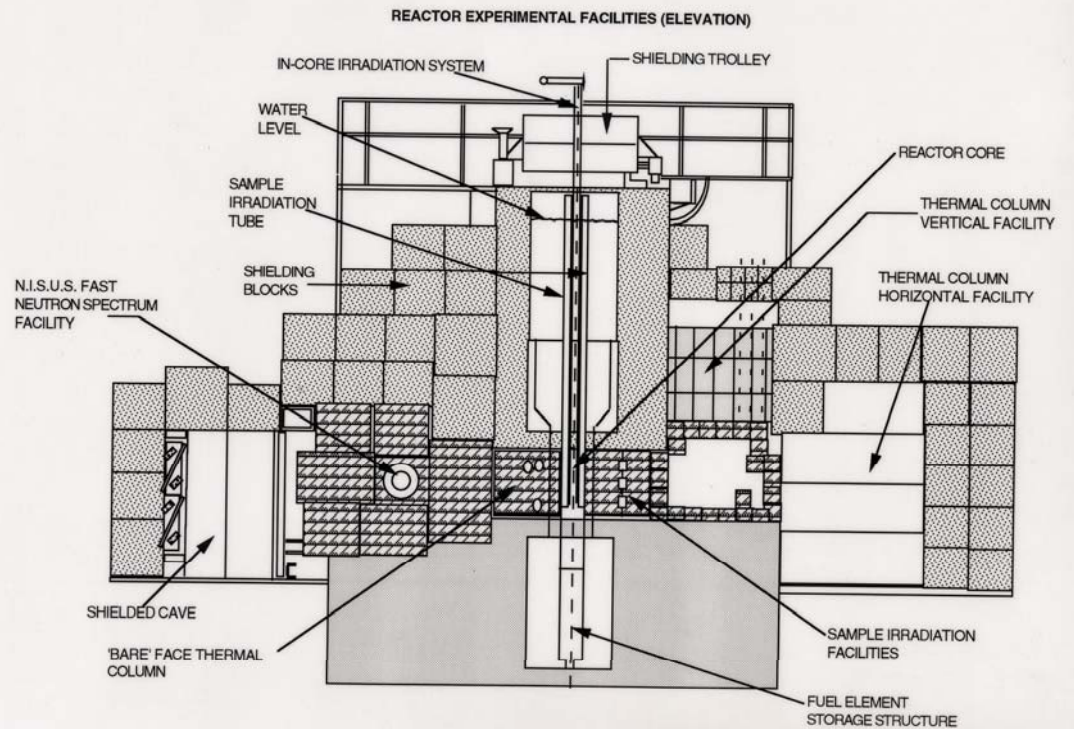
Locations Of Civil Nuclear Sites



RIP.....NESTER,
DIDO, GLEEP,
DIMPLE, JASON,
UTR300, URR, ICI
TRIGA.....

to provide a
national
resource
for research
neutrons

What CONSORT Looks Like



Why should a low power research reactor perform financial risk assessment?


- Support projects looking at fuel options
- Support case for external funding
- Evaluate probable *decommissioning costs*
- Identify level of *financial provisions*
- Meet the needs and concerns of stakeholders



Force Field Analysis

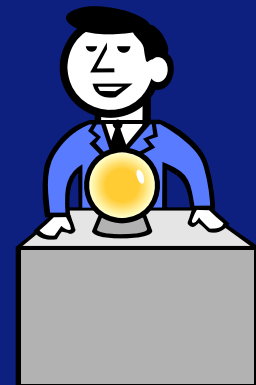
– Factors Driving Need for FRA

<p>Competition Abroad</p> <p>+ ISIS</p>	<p>No UK backend solution for fuel / possible time limits on receipt</p>	<p>Loss of £400K/a vs Predicted Decommissioning Costs £8M</p> <p>Sceptical College management</p>	<p>UK customers / investors want costing</p> <p>Need to refuel?</p>	<p>Regulators QQR</p> <p>IAEA</p> <p>Best practice for NDA</p>	<p>DRIVERS</p> 
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<p>Small facility – what can vary?</p>	<p>Does cost t & £</p>	<p>Does worry staff.....</p>	<p>Does worry customers.....</p>	<p>RESISTORS</p> 
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Financial Risk Assessment ?

- I have a friend that can decommission it for less than £1M in 18 months.....
- This is such a small facility – why bother?
- Can't we just shut the doors
- There can't be many risks to programme or cost can there?
- Why are the regulators involved...



Why is it the Reactor Future OPTIONS Project ?



- 5 Strategic Options

- 2008, 2012, 2017, 2028....

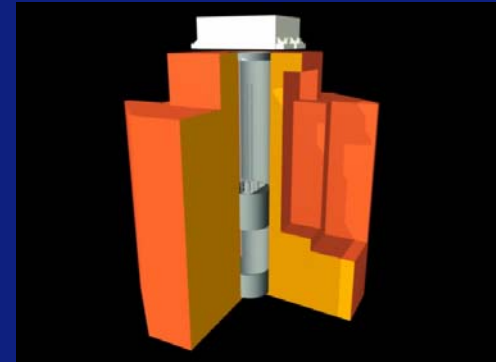
- Full/Partial refuelling, life/reactivity extension by optimisation & cooling or not, then decommissioning

- A** • Review refuelling and decommissioning strategy
 - I** • Assess and evaluate financial risks/financial costs
 - M** • Develop viable business base case

- S**

Possible Decommissioning Strategy if Financial Plan Fails?

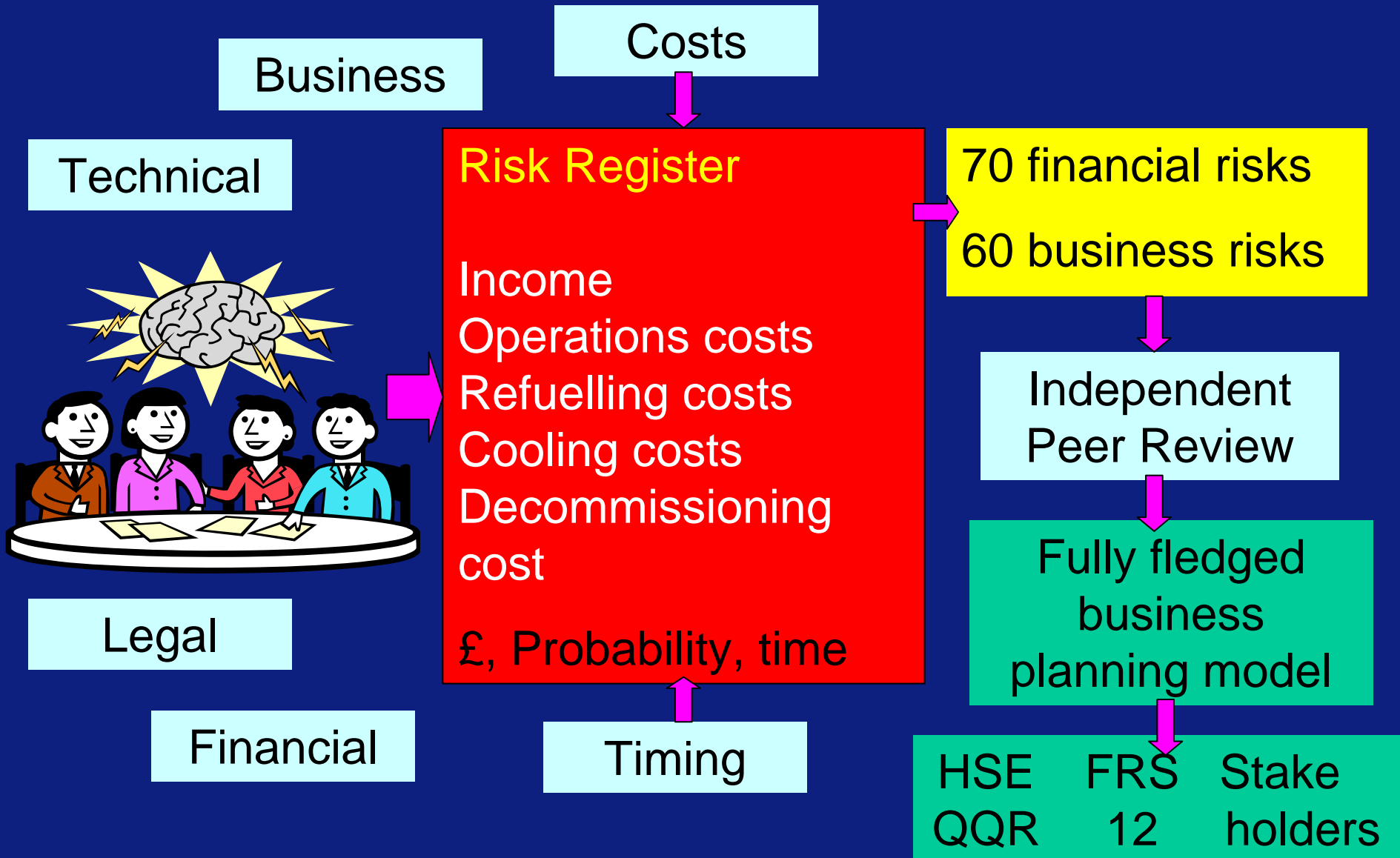
- Shutdown 2008
- Defuelling 2010
- Decommissioning 2010-2013
- Delicensing 2013
- Staff retention system to ensure appropriate staffing over 0-3, 3-5, 5-8/9 years
- Working with prime contractor to work down liability
- Decommissioning principles will include proportional security and safety emergency plans to suit hazards



Benefits to me?

- All business options and closure issues transparently carefully reviewed
- Budgets are now looked at seriously
 - Issues of budget uncertainty transparent and easily updateable using model
 - Issues of resourcing far better understood
 - Understanding that financial performance is to a large extent a political issue
- Stakeholders feel more involved: depersonalises the “I am looking after the reactor for history feeling
- Understanding that risk management is needed not just for reactor safety

Developing the Risk Register



A Business Operations And Decommissioning Strategy For 'Consort' UK Research Reactor

A Financial Risk Management Approach

Douglas J Gardner

Project Goals

- Review refuelling and decommissioning strategy
- Assess and evaluate financial risks/financial costs
- Develop viable business base case

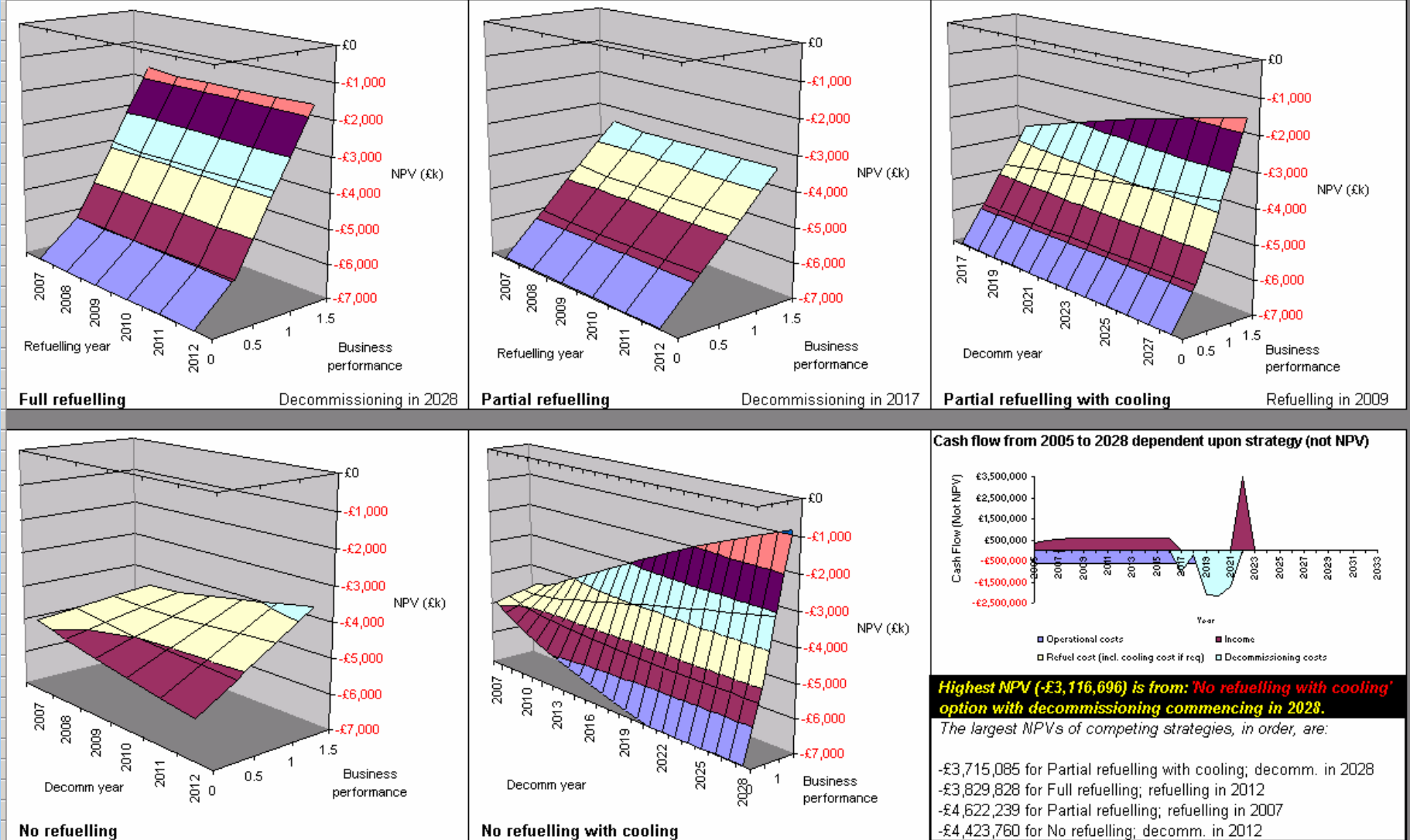
Other Critical Study Objectives

- Support Reactor Future Options Project
- Support case for external funding
- Evaluate probable *decommissioning costs*
- Identify level of *financial provisions*
- Meet the needs and concerns of stakeholders

5 Strategic Options

- Full refuelling with decommissioning (D)
- Partial refuelling with D
- Partial refuelling with improved building cooling followed by D
- No refuelling with D
- No refuelling with cooling and D

Graphical Outputs



Highest NPV (-£3,116,696) is from: 'No refuelling with cooling' option with decommissioning commencing in 2028.

The largest NPVs of competing strategies, in order, are:

- £3,715,085 for Partial refuelling with cooling; decomm. in 2028
- £3,829,828 for Full refuelling; refuelling in 2012
- £4,622,239 for Partial refuelling; refuelling in 2007
- £4,423,760 for No refuelling; decomm. in 2012

Graph max £

Discount rate

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ICRC Document Risk Register - INCOME

All unspecified costs to have uncertainty included in triangular distribution of -50% 100% +200% (this is consistent with BNFL work)

Risk no	Title	Description	Distribution/magnitude	Comments
I1.	Reliability of reactor	Reactor does not function all the time. This figure represents the loss of income from down time	Discrete 75% fully operational 20% of time 10% loss of income 4% of time 25% loss of income 1% of time 100% loss of income	Figures represent the loss of total annual days of income – applies to each and every year whilst operating
I2.	Loss of staff	Reactor cannot function because of requirement for staff for safety licence	Discrete 75% fully operational 20% of time 10% loss of income 4% of time 25% loss of income 1% of time 100% loss of income	Figures represent the loss of total annual days of income– applies to each and every year whilst operating
I3.	Loss of licence	Licence to operate withdrawn	0.1% chance of occurrence resulting in permanent closure	Annual risk

Scenarios and Outputs Sheet

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total (Net)	-£1,064,210	-£635,529	-£563,073	-£1,045,011	-£239,727	-£29,965	£3,218	-£837,191	-£331,203	-£889,913
Operational costs	-£1,426,556	-£1,047,947	-£1,048,061	-£1,045,011	-£1,073,542	-£1,292,087	-£1,082,772	-£1,049,492	-£1,161,892	-£1,059,281
Income	£362,346	£412,418	£537,789	£0	£833,815	£1,262,122	£1,085,990	£212,301	£830,689	£169,368
Refuel cost (incl. cooling cost if req)	£0	£0	-£52,801	£0	£0	£0	£0	£0	£0	£0
Decommissioning costs	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0

Refuelling choice

Breakeven target = £317,460 income additional to everything included in the Business Plan

Year

Refuelling impact on income %

Calculate / Recalc All Scenarios

Decommissioning

Year

2017

Run All Scenarios continuously

Business performance

Maximum increase %

0%

Year when achieved

2008

Discount rate

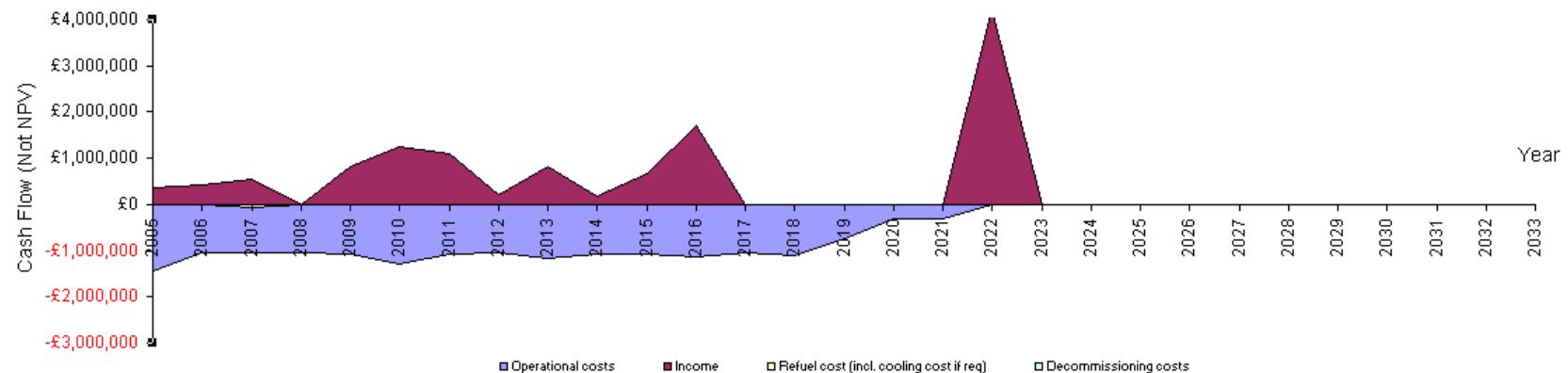
0.03

NPV

-£4,633,142

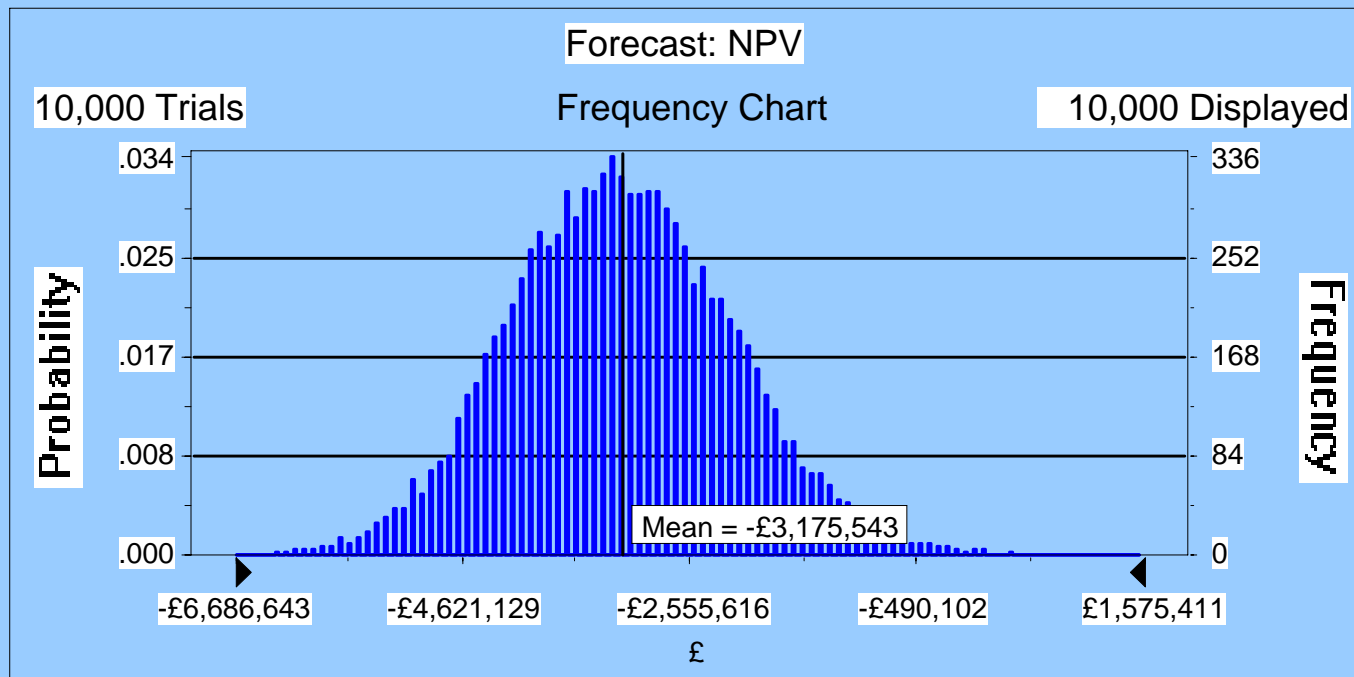
Model mode:

Stochastic



NPVs for mid-term option

No refuel, cool, decommission in 2017

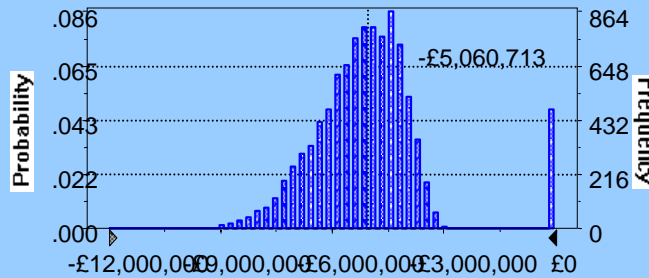


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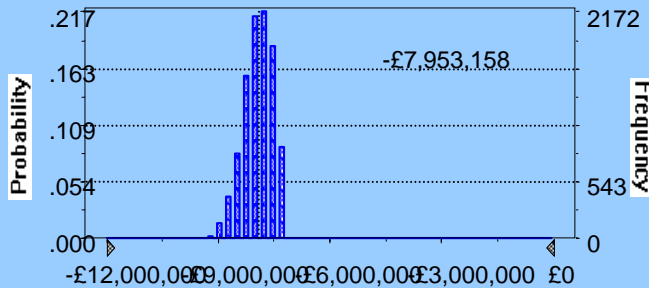
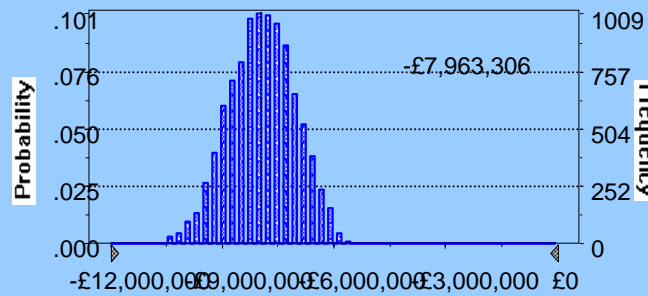
Impact of NDA related risks

Forecast: Decommissioning cost



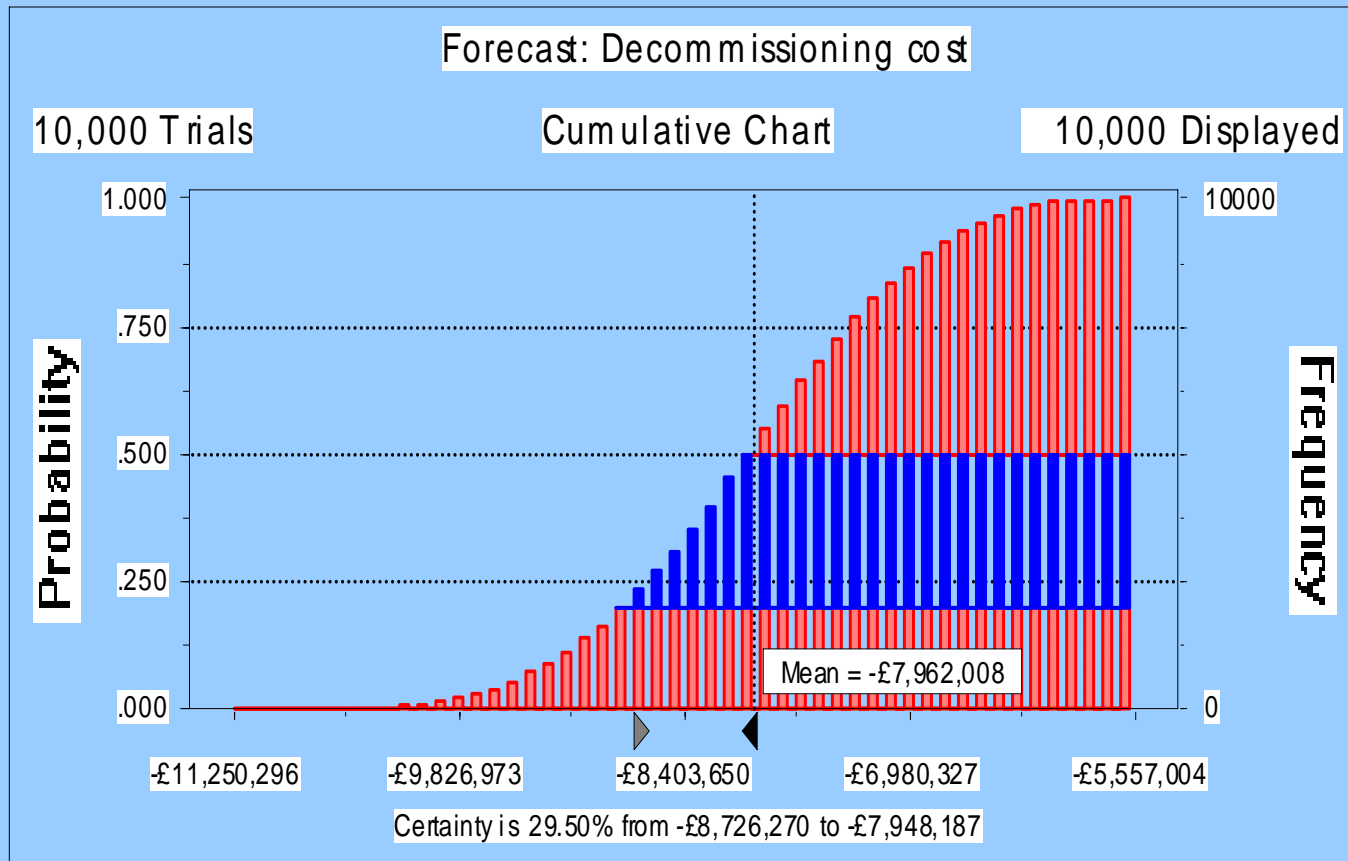
All NDA risks included,
support and regulation

Only NDA regulatory
risks



All NDA risks
excluded

Cumulative frequency graph



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Forecast Decommissioning Costs

FORECAST: Decommissioning cost

Percentiles:

<u>Percentile</u>	<u>Value</u>
0%	-£11,250,296
5%	-£9,480,393
10%	-£9,163,300
15%	-£8,933,881
20%	-£8,740,158
25%	-£8,587,502
30%	-£8,437,423
35%	-£8,302,526
40%	-£8,177,330
45%	-£8,071,708
50%	-£7,946,124
55%	-£7,831,711
60%	-£7,711,499
65%	-£7,586,888
70%	-£7,449,788
75%	-£7,315,205
80%	-£7,159,463
85%	-£6,984,500
90%	-£6,775,015
95%	-£6,486,647
100%	-£5,557,004

Unplanned Decommissioning Risk

- *Loss of License, Significant Accident, Safety Case Obsolescence; 'Green' pressures*
- Low probabilities but decommissioning would likely be inevitable
- Inability to fully provision
- Unplanned budgetary pressure

Risks Not Fully Defined

- Artificial cooling - 3 strategies are dependant on technical approach - not yet proven
- ILW and spent fuel reprocessing issues - solutions largely outside ICRC control
- Need additional resources to resolve

Key Findings 1

‘A general strategy with no refuelling and efficiency improvement through additional cooling and optimisation is shown to be financially dominant.’

Key Findings 2

‘A mid-term planned closing date of 2017 is shown to give the best net present value consistent with income assumptions (from ICRC business and external funding opportunities for decommissioning) and technical life of the reactor with cooling; the approach is flexible and subject to annual review of assumptions.’

Key Findings 3

- An improved basis for covering the costs of planned decommissioning has been presented through a rationale for provisioning. This basis and underlying rationale have been agreed with the Imperial College London auditors. The risk model is being used in discussions with potential nuclear insurers to cover further identified and quantified financial risks related to closure earlier than planned.