MELCOR Deck Generator

UK MELCOR ACTIVITIES

To EMUG, March 2015

Introduction

- Amec Foster Wheeler is a large British Nuclear, Oil and Gas Company of 40,000 employees in over 40 countries.

- Over 3,000 nuclear scientists and engineers world-wide.

- Amec Foster Wheeler is also heavily involved in the British naval reactor programme.

- Department works with civil and naval sectors of the nuclear market

- MELCOR, SOPHAEROS, RELAP, TRACE, FDS, PANTHER

- RESTRICTED work!

Presentation Outline

- Very brief overview of MELCOR activity in the UK
- Introduction to the Deck-Gen tool
- Demonstration
- Future plans

Main AIM

- Introduction to a potential CSARP tool
- Get user opinion (feedback)

Nuclear Power in the UK

Non-generating

generating

Dounreay
DFR, PFR

Hunterston
A, B
Chapelcross
Calder Hall
Heysham
1, 2
Wylfa
Trawsfynydd
Torness
Hartlepool
Sizewell A, B
Berkeley Oldbury Bradwell
Hinkley Point
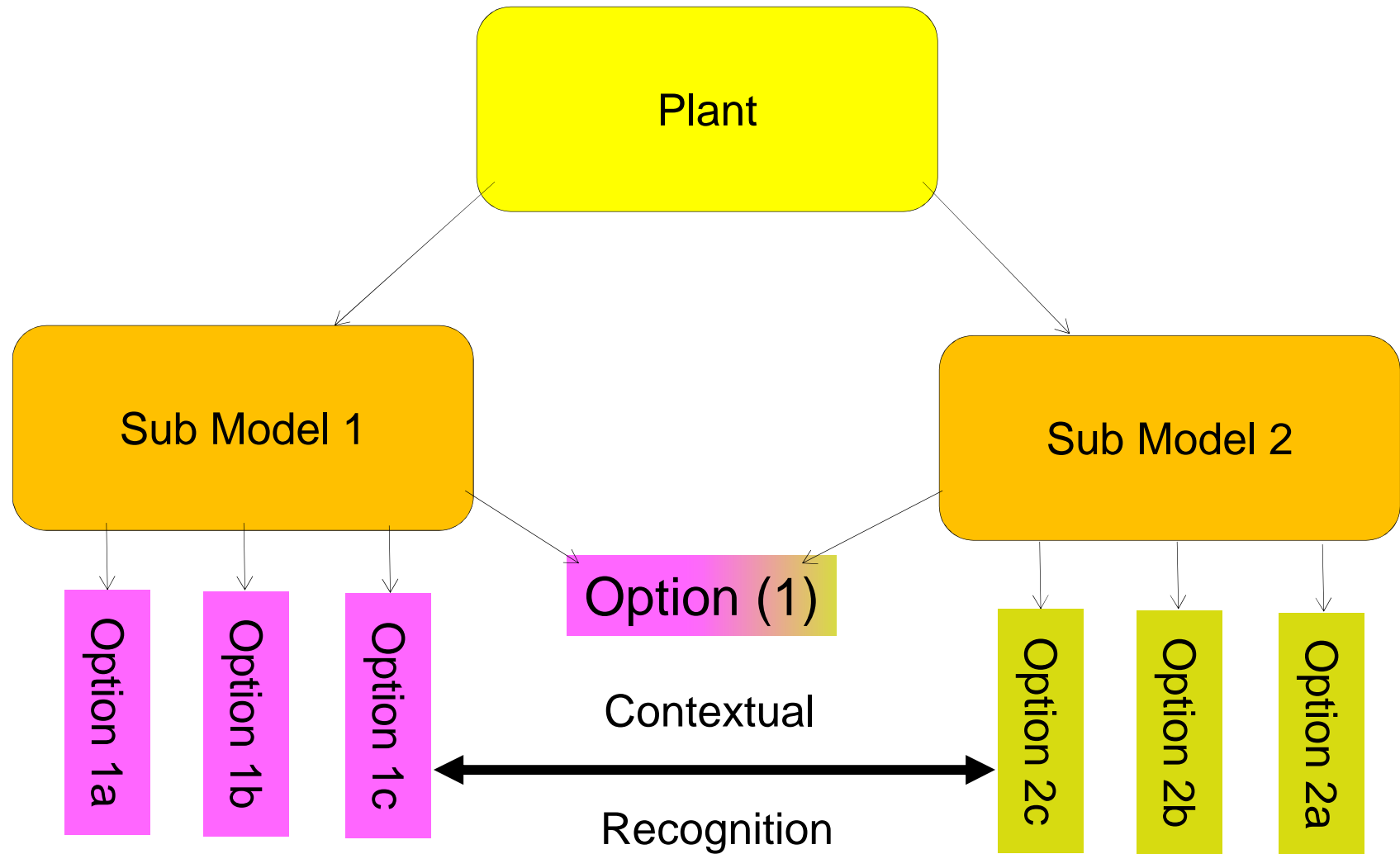A, B
Dungeness
A, B
Winfrith

- First commercial nuclear power station in the world at Calder Hall in 1956.

- Although the UK suffered the nuclear dark age, it retains a strong capability is all areas, from plant design to manufacture, operation and decommissioning in the naval and civil sectors.

- UK nuclear attitude is positive post Fukushima with the GDA for EPR complete and the GDA for ABWR ongoing.

MELCOR Activities in the UK

- MELCOR has been used to model British naval LWRs as an independent safety assessment tool since 1990s.

- Recent advances in MELCOR means it is now of interest to the naval sector.

- Unique plant and core design – challenge to use MELCOR, but MELCOR is very versatile!

- British development of a Deck-Gen tool which has the potential to be a CSARP contribution.

- Application of a fusion version of MELCOR applied to ITER projects.

The Deck-Gen

- 4 Principal purposes
  - QA – File control
  - Write COR model with primitive quantities
  - Batch
  - Auto nodalisation

- In MELCOR 2.1, card format became ordered in term of "packages" rather than "systems".

- Old deck structures could still be preserved through use of the ((())) syntax but complex decks can be cumbersome, especially when dealing with FL_VLV. Complex comment block logical commands.

- Created a tool that easily switches on or off groups of cards in any configuration and provides a simple way to apply global variables through out the deck.

- Tool is based in Microsoft Excel – deck is imported - one tab per code fragment. User has full control on the structure of the deck.
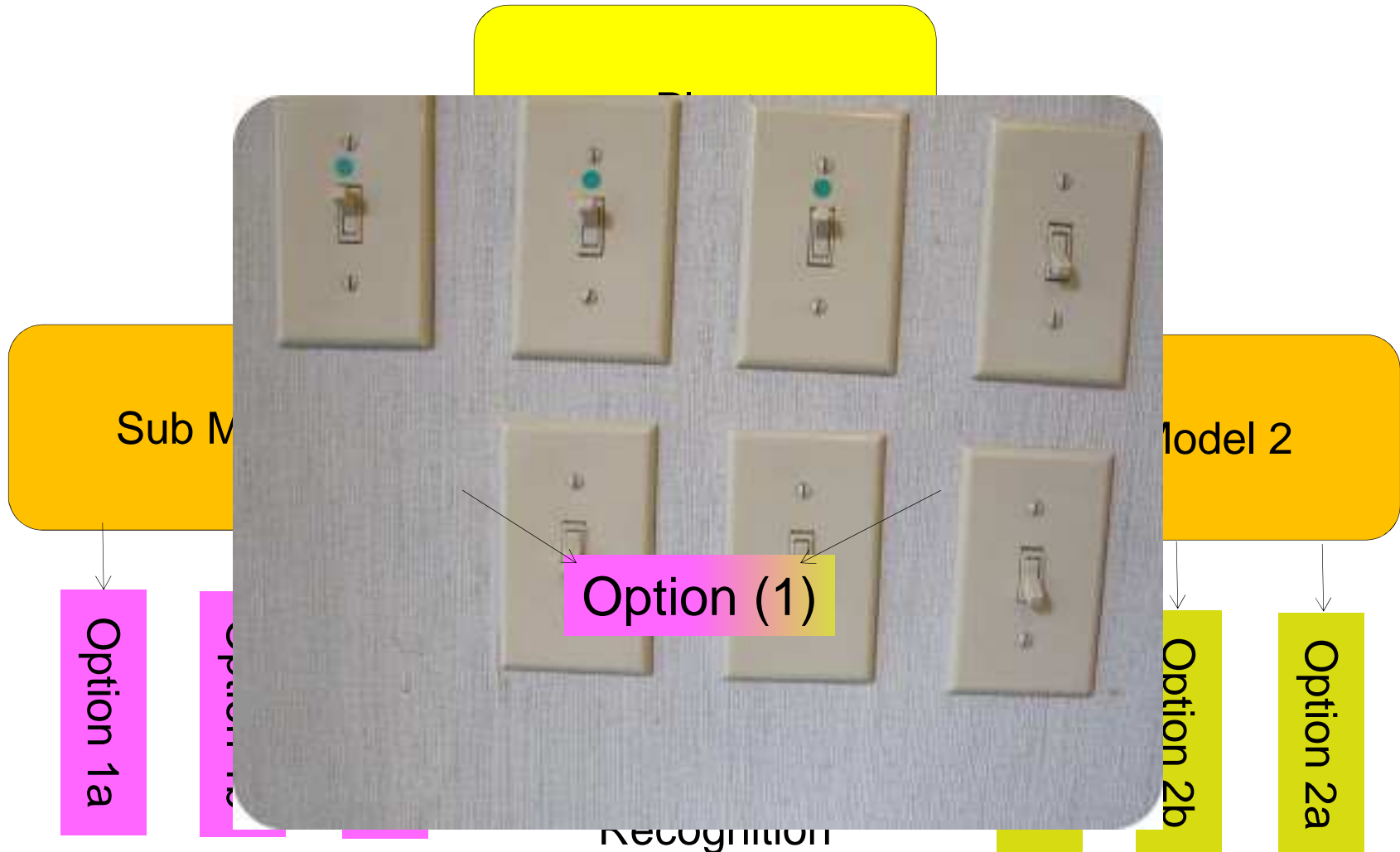
- One Master Deck, from which anything can be derived through the "Problem Definition".

- Output ordering.

- Organises output into directories
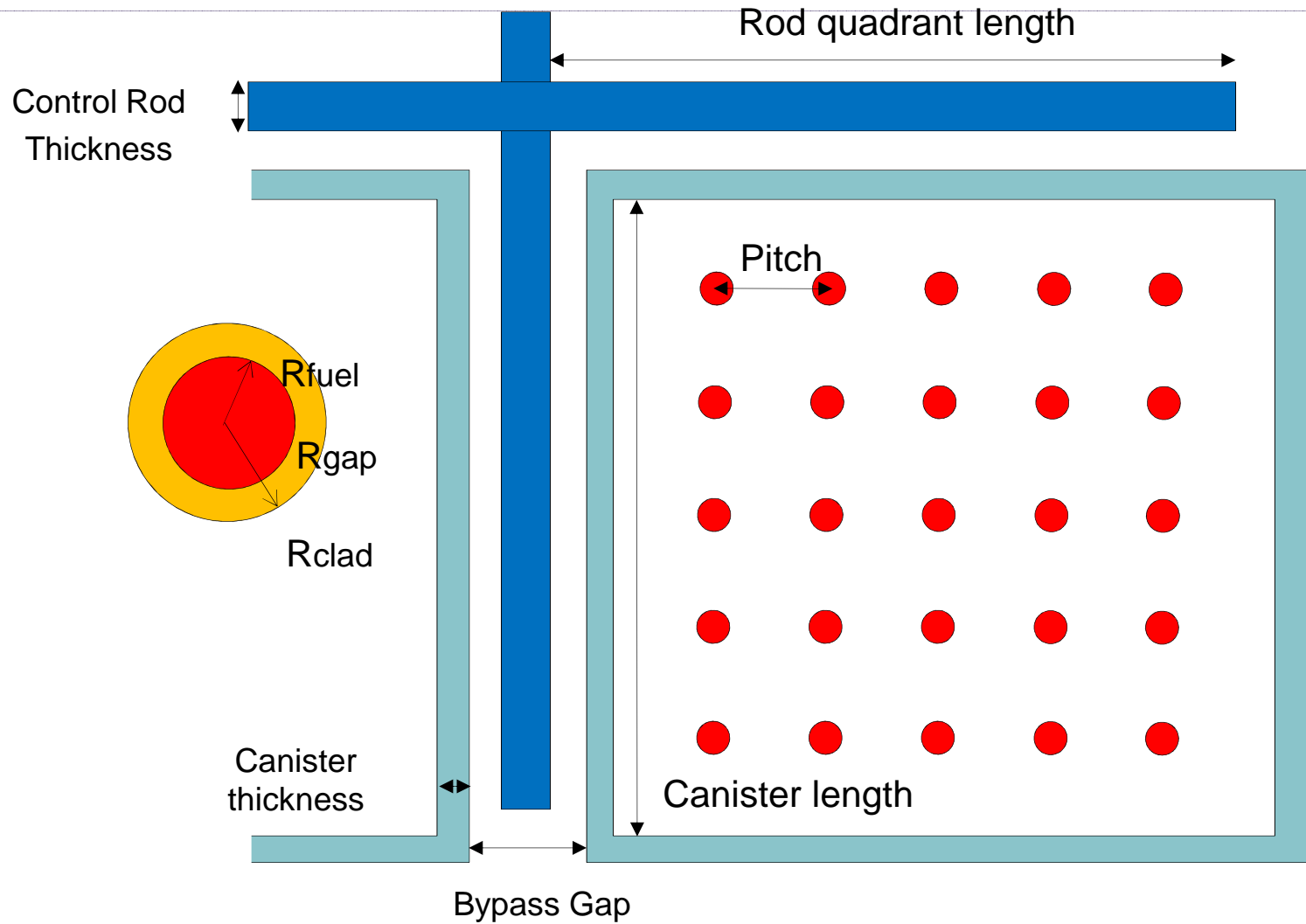
- Automatically diarises changes to the input deck.

Option (1)

Sub M

odel 2

Option 1a

Option 2b

Option 2a

Recognition

Core Model Builder

Rod quadrant length

Control Rod Thickness

Pitch

Rfuel

Rgap

Rclad

Canister thickness
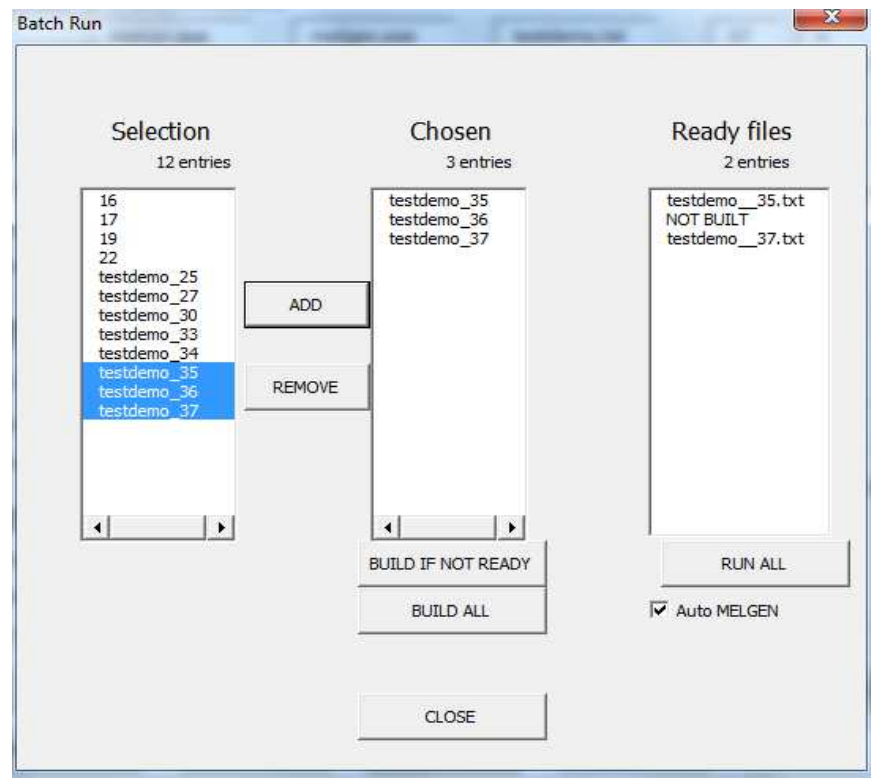
Canister length

Bypass Gap

Batch

- Run a batch of deck builds, MELGENs or MELCORs for a selection of problem definitions.
- Reports on status
- Make one change in the input deck and see how it affects any number of test cases.

Auto-Renodalisation

- COR renodalisation is notoriously difficult in MELCOR. Links with:
  - CVH
  - FL
  - DCH
  - RN1
  - TP
  - HS
  - CF

- Define un-movable node boundaries
- Split any "Major node" into n subnodes (not restricted to fueled region)
- Custom nodalise COR to consider power profile
- Define a bespoke CVH nodalisation in the COR region

Limitations and code status
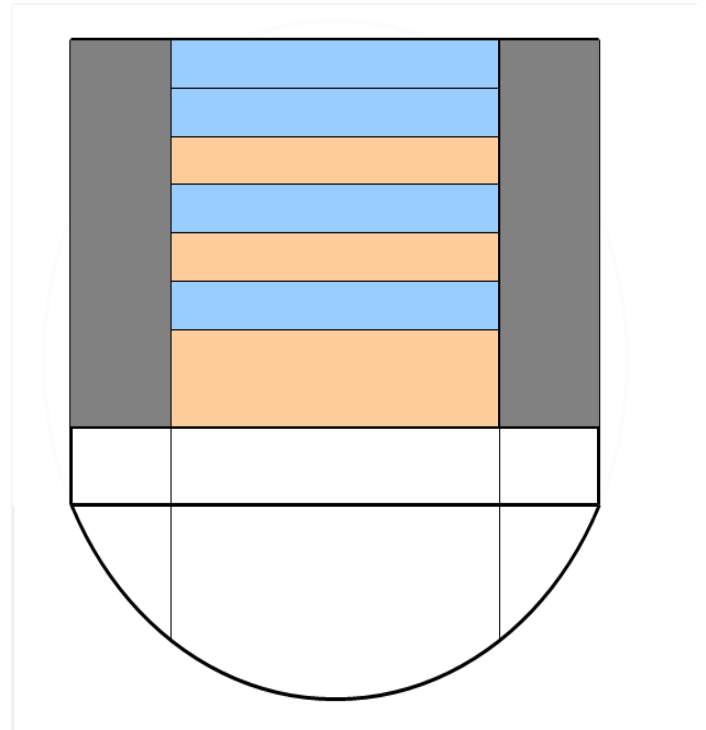
- Currently cannot nodalise radially in an automatic fashion but it has been coded with that in mind.

- The tool is in constant use so bugs are actively being ironed out.

- Functionally complete for our application last November.

- Now reasonably clean.
  - Not tested in Excel 2010
  - Not tested in Excel 2013

Demonstration

Some Quick Nodalisation Results

Longer term development
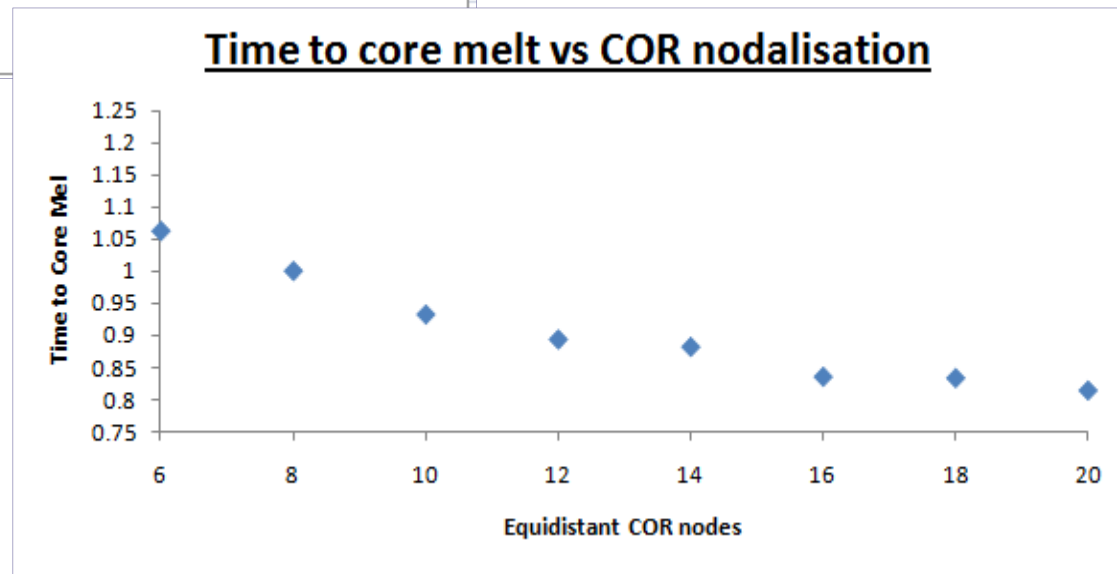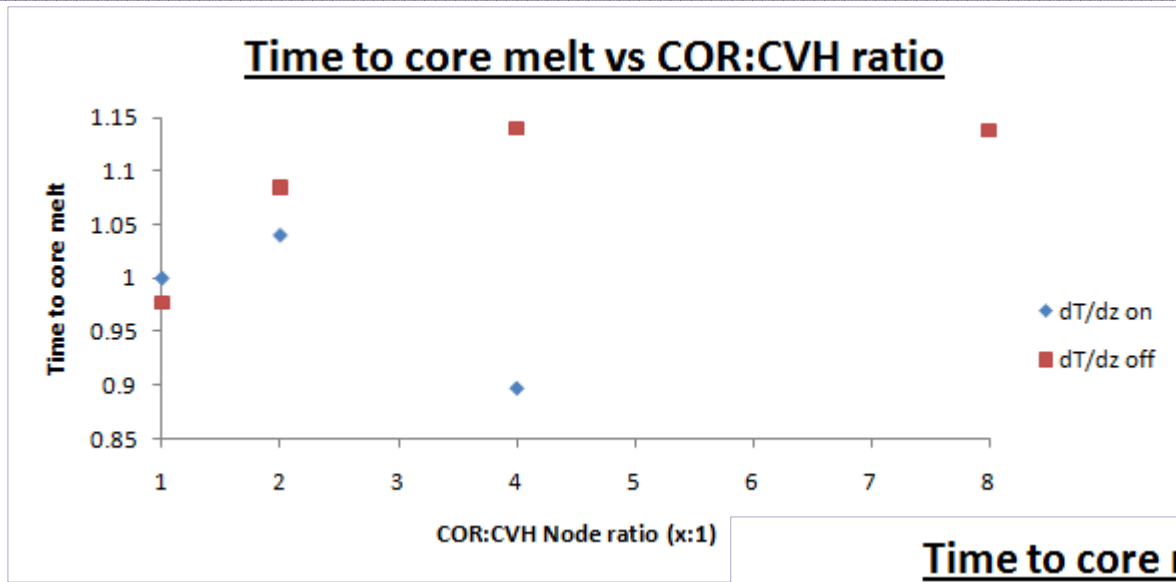
PHASE 1

- DeckGen is now flexible enough to be used for any deck in principle but setting up requires specialist knowledge: Need to streamline the process:

- Develop a simple GUI for setting up the capability.

- It'll make use of the "CTYPE" card as a means of labelling your model into systems and Control Functions

- Allow user full flexibility in adding systems and sub models, including declaring commonality.

PHASE 2

- Include automated radial renodalisation function

- Final testing (Amec-Foster Wheeler and Sandia)

Questions

Acknowledgments to Ken Hall

ANY QUESTIONS?