

The Role of Nuclear Criticality Safety in Enabling the Transport of HEU (and Other Fissile Materials) to Support Global Strategic Removal Projects

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Nuclear Transport Solutions (NTS)

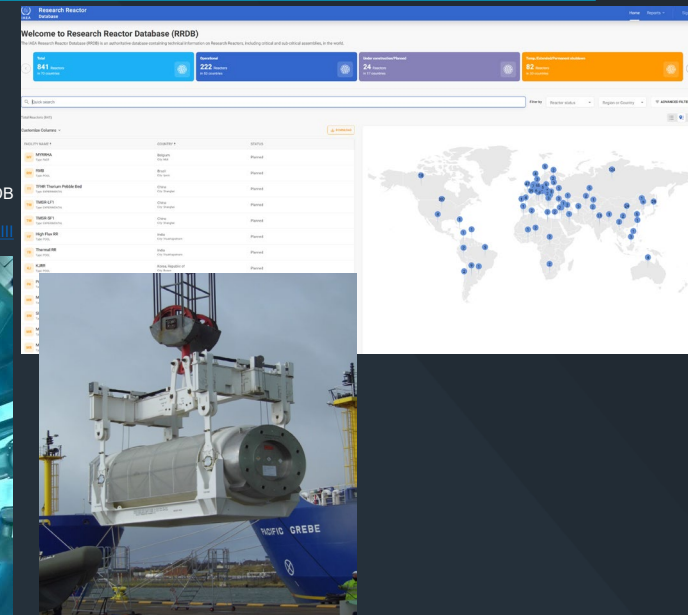
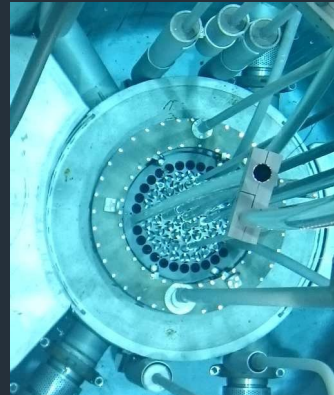
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Research and Test Reactors

- 222 operational research and test reactors in 53 countries.
- In comparison with nuclear power reactors they are:
 - Smaller and simpler design.
 - Less powerful.
 - Operate at lower temperatures.
 - Require less fuel → less waste.
 - Fuels from 5 to 93% enriched Uranium-235.

Source: RRDB

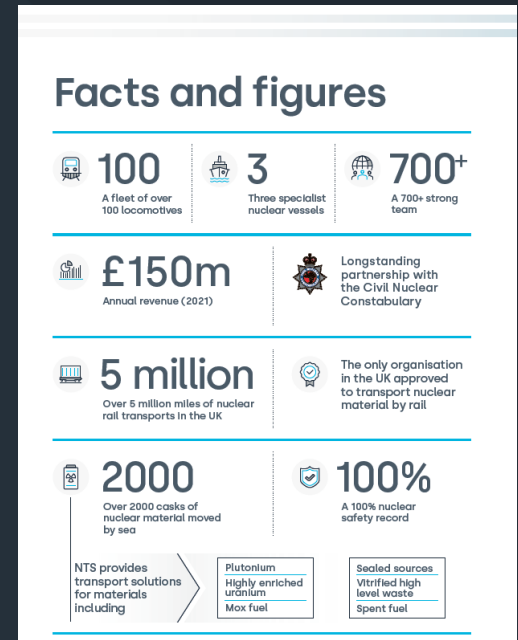
Source: [TRIGA MkIII](#)



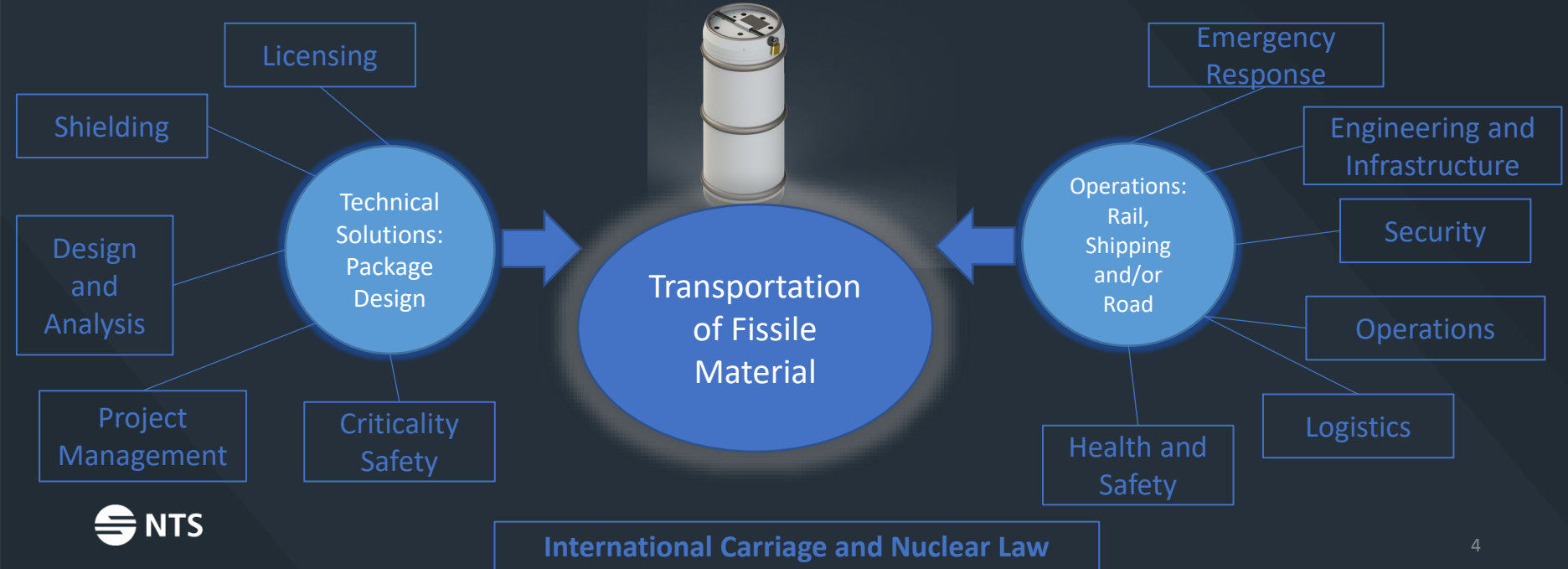
Nuclear Transport Solutions (NTS)

We are a leading global provider of safe, secure and reliable nuclear transport solutions that make the world a safer and more sustainable.

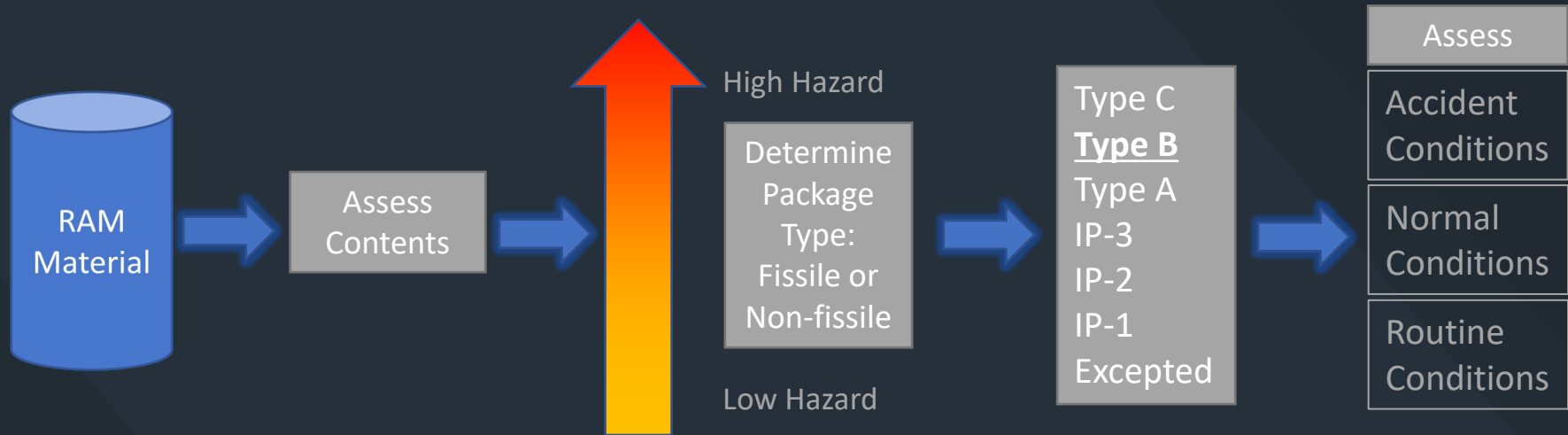
- Part of the UK's Nuclear Decommissioning Authority (NDA).
- Experts in complex nuclear transport solutions.
- NTS was formed from INS, DRS and PNTL covering technical solutions, rail and shipping.
- Transport a full range of nuclear materials including vitrified residues, MOX, HEU, LEU and separated Pu.



Transportation of Fissile Material

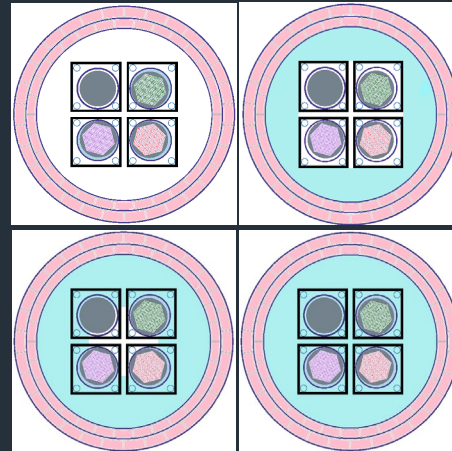


The Solution to Transportation

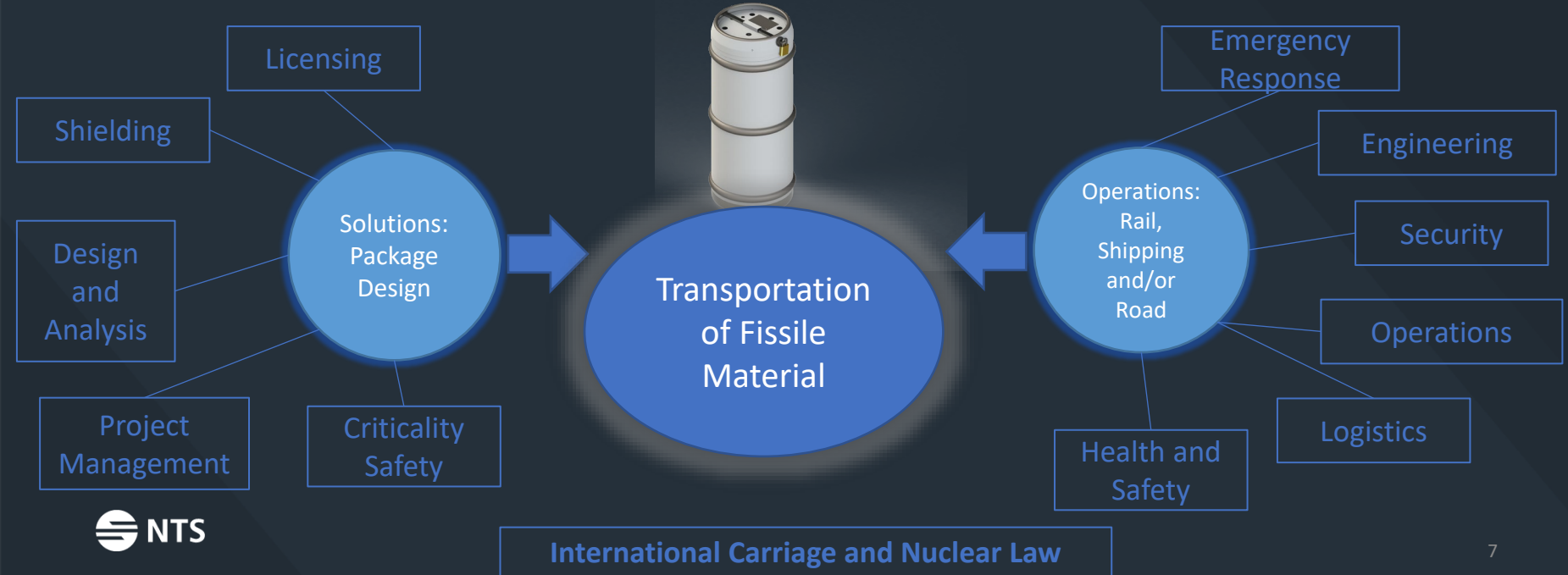


Package Design Safety Report (PDSR)

- Package licensing requires submission of a Package Design Safety Report (PDSR) to the Regulator.
- The PDSR includes all engineering and safety aspects for package for Normal and Accident Conditions of Transport (NCT/ACT).
- Requires support from various technical experts e.g.:
 - Impact/ Structural.
 - Thermal/ Stress.
 - Shielding.
 - Criticality.

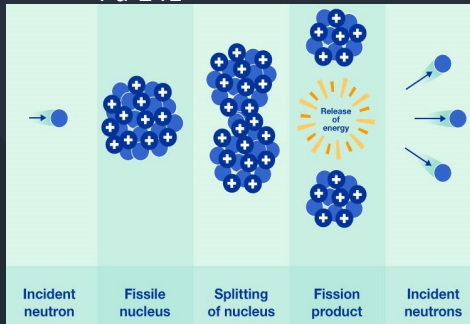


Transportation of Fissile Material

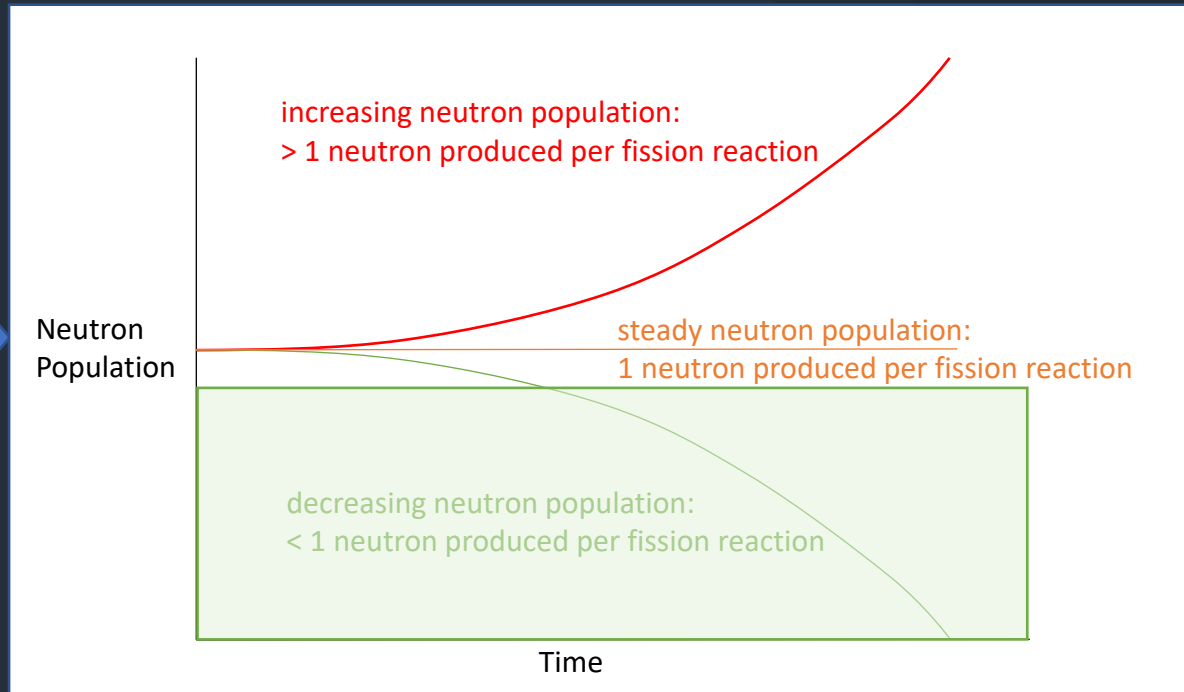


Criticality

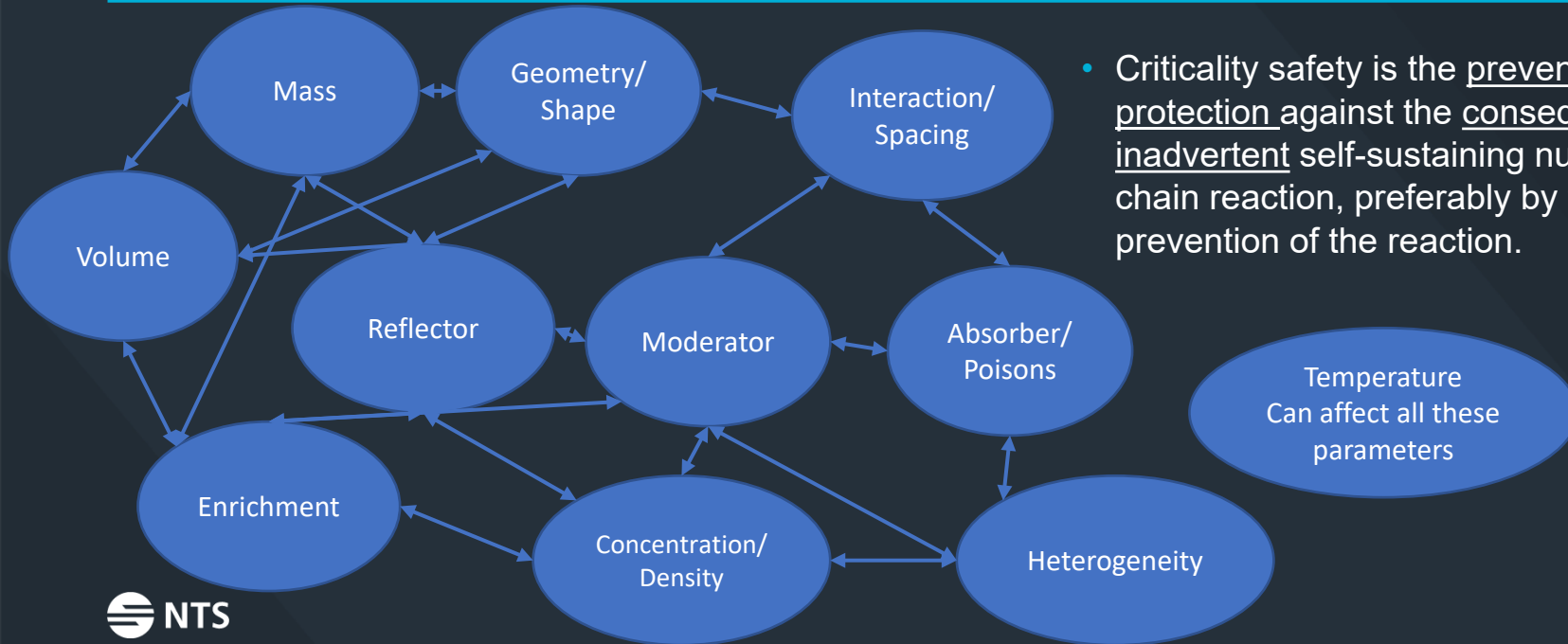
U-233
U-235
Pu-239
Pu-241



Source: [Graphic: A. Vargas/IAEA](#)

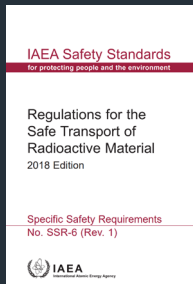


Criticality Safety



- Criticality safety is the prevention/ protection against the consequences of an inadvertent self-sustaining nuclear fission chain reaction, preferably by the prevention of the reaction.

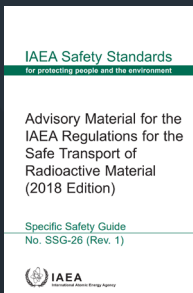
The Transport Criticality Safety Assessment



- **Aim:** Determine a Criticality Safety Index (CSI) for package movements.

- Based on the requirements in IAEA SSR-6.

- A transport criticality safety assessment investigates Normal Conditions of Transport and Accident Conditions of Transport (NCT and ACT).



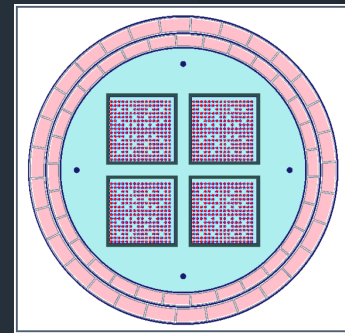
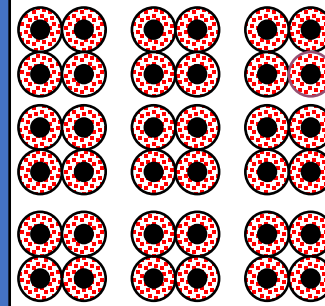
- Site or plant-based assessments are probabilistic and follow a very different set of regulations.

Initial Scoping Phase

Interface with various disciplines to gather data

Perform some initial scoping calculations

- Design drawings
- Contents and fuel details
- Damage conditions
- Stress conditions
- Temperature profile
- Fuel break up
- Fissile release



Normal Conditions of Transport (NCT)

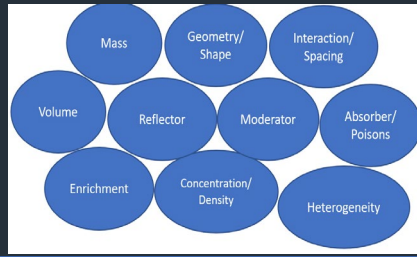
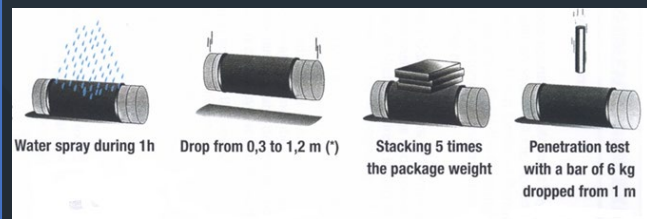
NCT Modelling

Minor accidents or mishandling of the package that could occur during transit

Single package model and an array of packages

Perform analysis and self-checks

Independent QA



Accident Conditions of Transport (ACT)

ACT Modelling

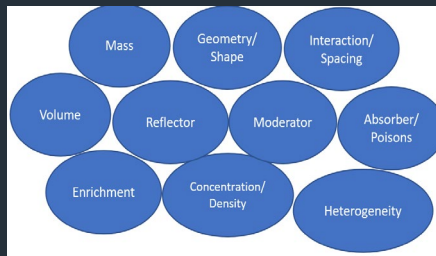
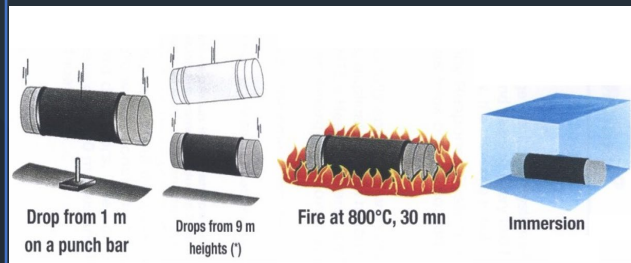
Conditions under which the package sustains damage that is equivalent to that from a severe and credible accident

Single package model and an array of packages

Run analysis and perform self-checks and initial assessment

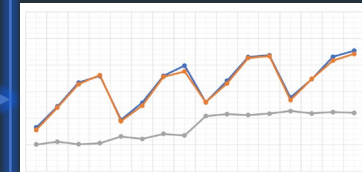
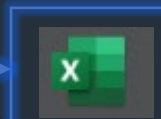
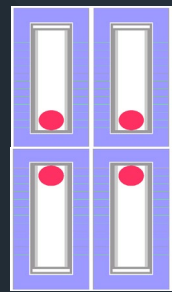
Low temperature assessment to -40°C

Independent QA



Results

Post-processing and report production



Calculate CSI:
Based on the safe number of
packages in an array for NCT and
ACT



Final Thoughts

- Criticality safety assessments are a fundamental part of the business area that enable and dictate the carriage of nuclear materials on various modes of transport i.e. ship, rail and road.
- We have enabled successful transport projects to take place, delivering cargo from research and test reactors, and vulnerable locations around the world in support of individual customers needs and Governmental programmes of material removal.
- The requirement to transport fissile material should be considered in the design phase, and if necessary, engage with competent authorities and other stakeholders at the earliest stage.



Thank you

- Thank you for listening.
- If you have any questions or want to speak further please contact:
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“Without transport there is no nuclear industry.”