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Regulatory Reviews of Criticality Safety Systems for New Generation of Storage Casks and Transportation Packages

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Outline

- Regulatory Requirements
- Cask Design Evolution
- Criticality Safety Systems
- Burnup Credit
- Summary

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Criticality Safety Regulatory Requirements for Transportation Packages (casks)

- 10 CFR 71.55 (b)
  - "… a package used for the shipment of fissile material must be so designed and constructed and its contents so limited that it would be subcritical if water were to leak into the containment system, or liquid contents were to leak out of the containment system so that, under following conditions, maximum reactivity of the fissile material would be attained…"

Criticality Safety Requirements for Transportation Casks (cont.)

- 10 CFR 71.83
  - "When the isotopic abundance, mass, concentration, degree of irradiation, degree of moderation, or other pertinent property of fissile material in any package is not known, the licensee shall package the fissile material as if the unknown properties have credible values that will cause the maximum neutron multiplication."

Regulatory Criticality Safety Requirements for Storage Casks

- 10 CFR 72.124
  - " (a) Design for Criticality Safety. Spent fuel handling, packaging, transfer, and storage systems must be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. …"

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Transportation Cask Design Evolution

- Older Generation of Casks Designed for Younger and Hotter Spent Fuels
  - Radiation and heat were the main driving design parameters for a given cask weight category
  - Criticality safety less of a driving parameter due to lower payload for hotter spent fuels
  - No need to invest in efforts to take advantage of Burnup Credit – Fresh Fuel assumption based on "flux trap" design was conservative and adequate for criticality safety purpose

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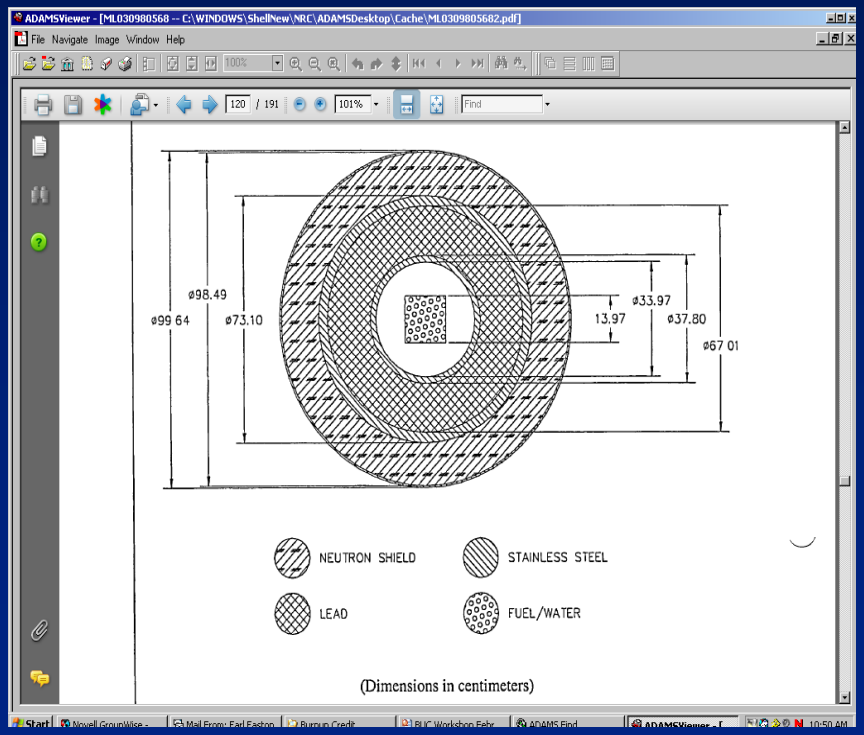
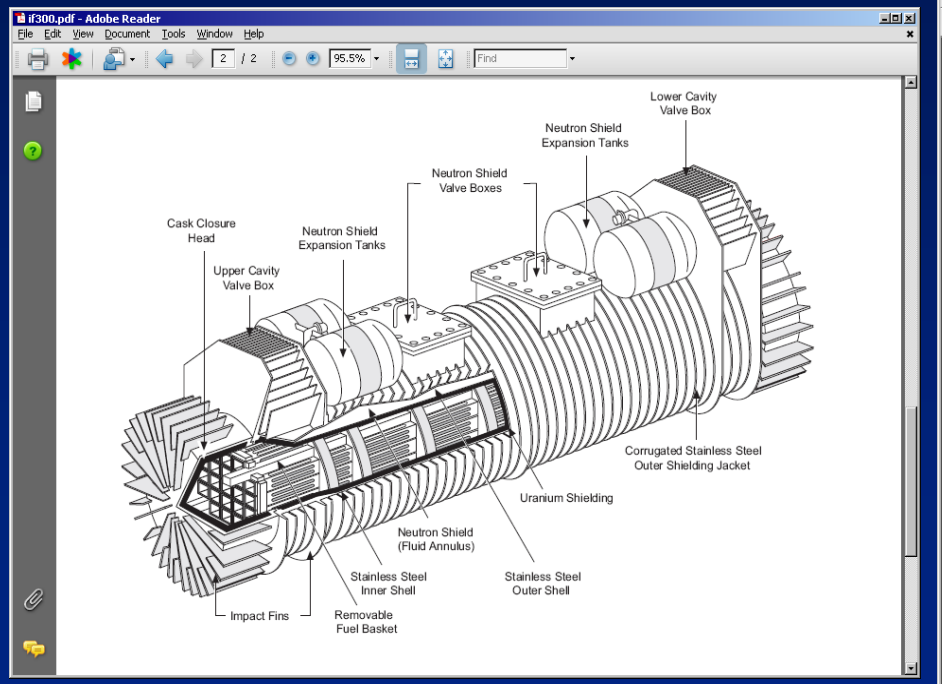
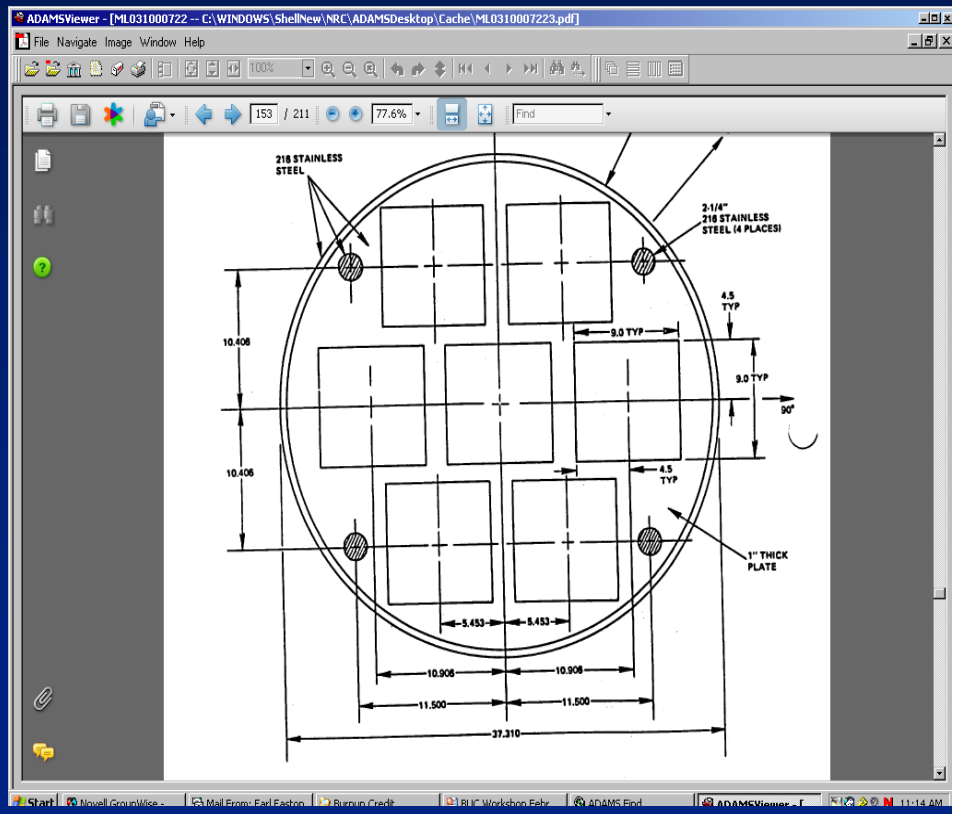
Transportation Cask Design Evolution (NAC-LWT Cask)



Transportation Cask Design Evolution (IF-300 Cask)

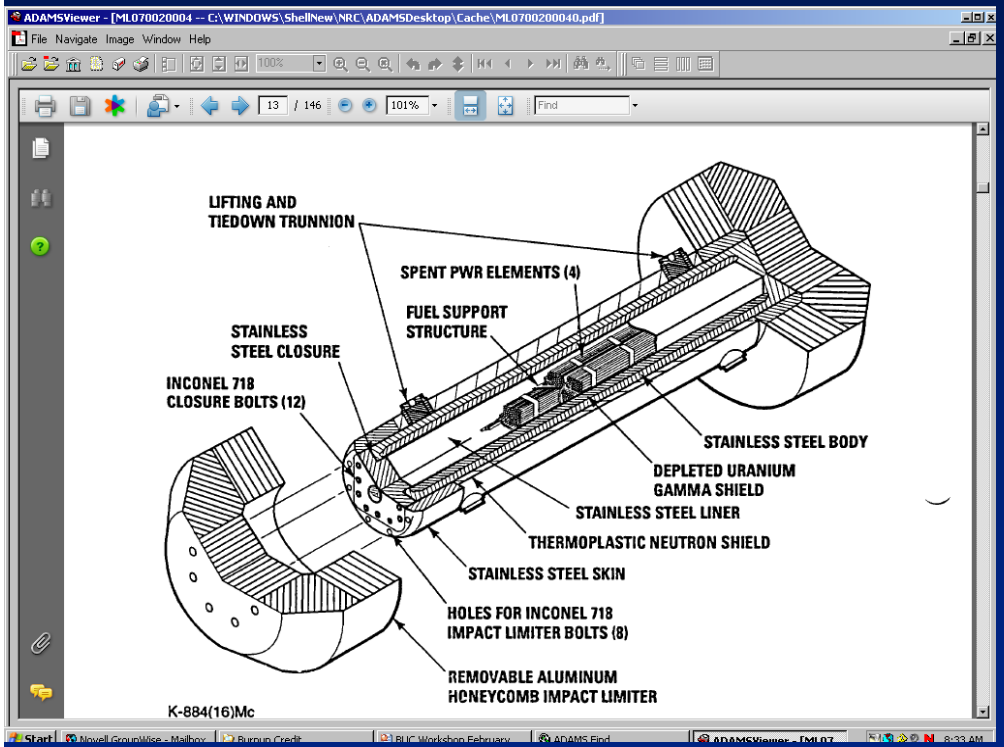


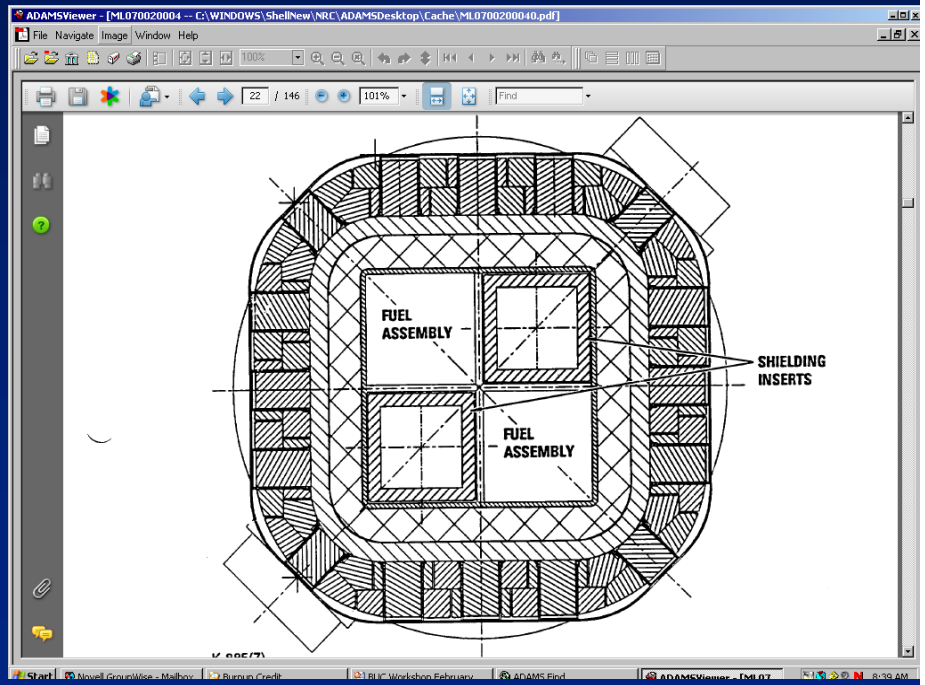


Transportation Cask Design Evolution (cont.)

- New Generation of Casks Designed for Older and Colder Fuel
  - Increasing cask payload for older and colder spent fuel meant economic advantage and competition among cask vendors
  - Higher payload meant higher fissile loading which made Fresh Fuel assumption too penalizing.
  - Burnup Credit became more viable

Transportation Cask Design Evolution (GA-4 Cask)





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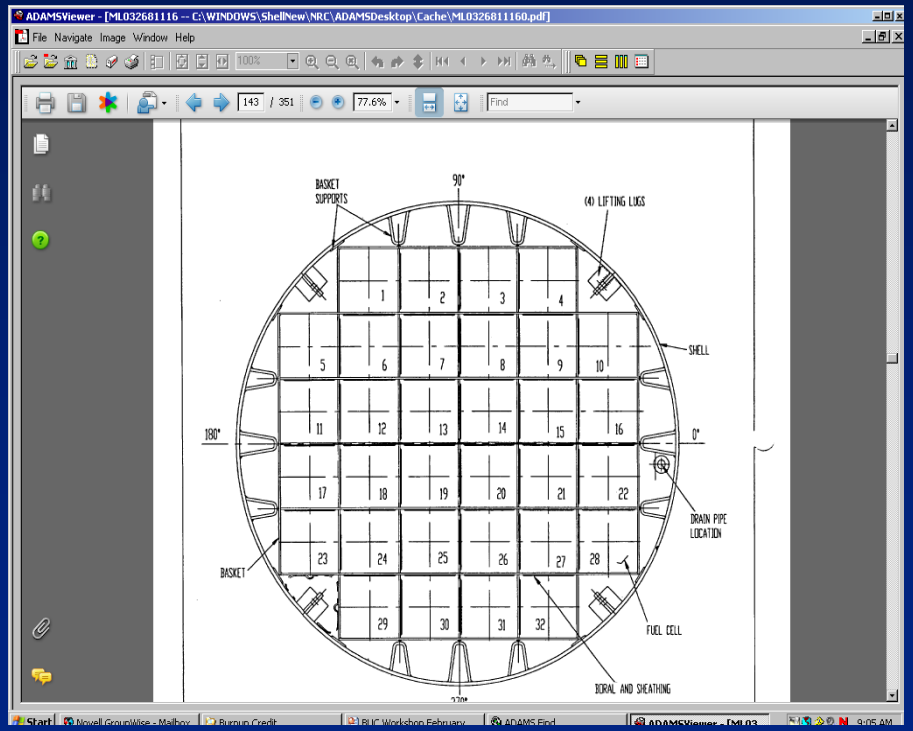
Transportation Cask Design Evolution (HI-STAR 100 Cask)



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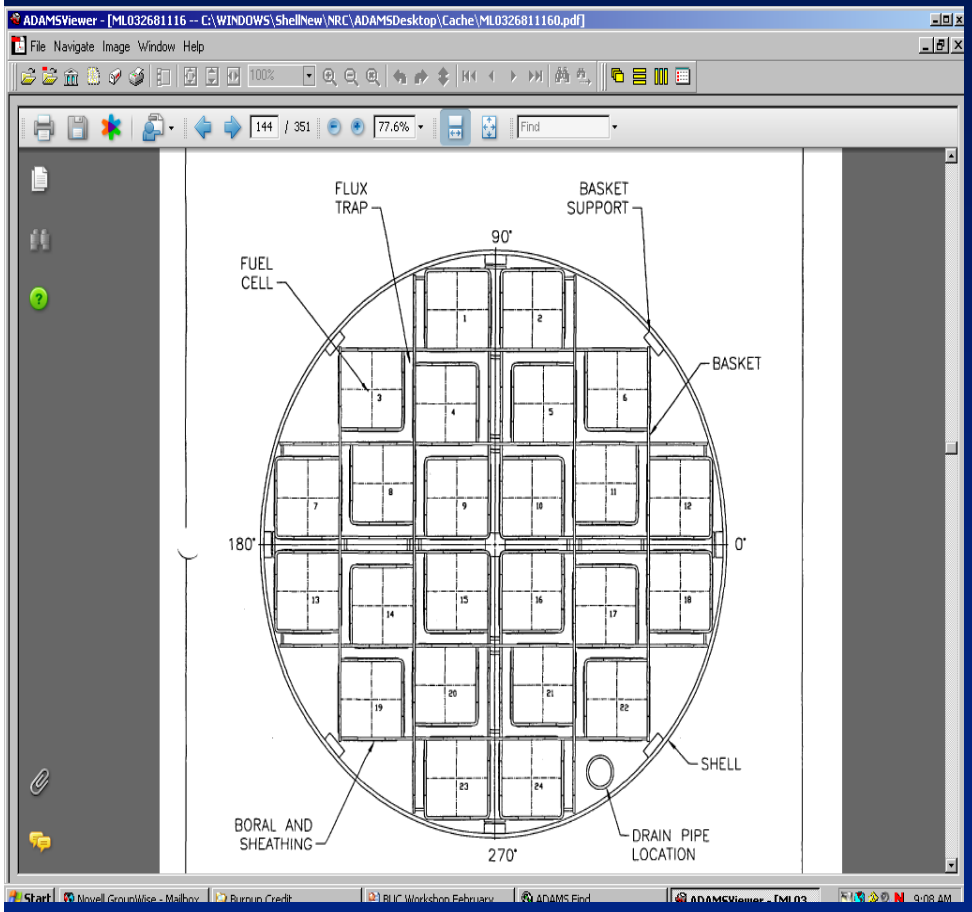
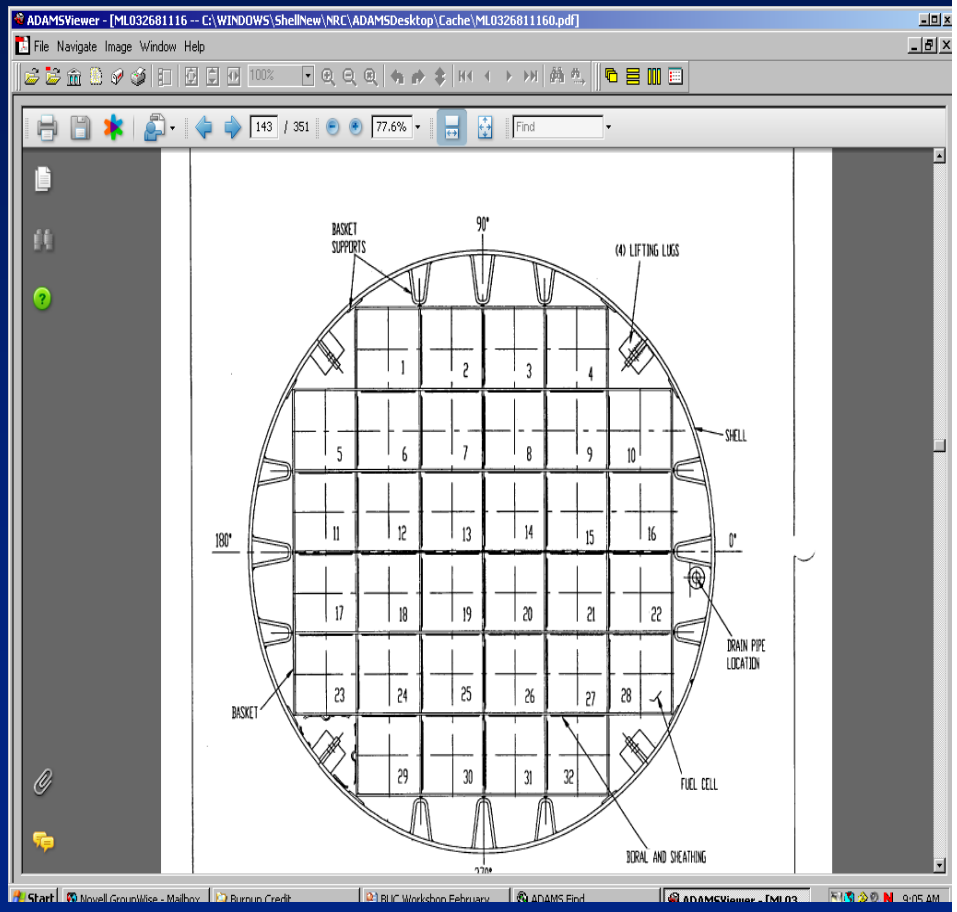
Transportation Cask Design Evolution (Fresh Fuel vs. Burnup Credit Basket)





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Storage/Transport Casks

- Current casks with storage license are coming in for transport certificate request using Burnup Credit to satisfy criticality safety requirement
- Currently several applications under review by the staff

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Burnup Credit

- Staff has provided guidance on actinide-only Burnup Credit in Interim Staff Guidance (ISG)-8, Rev. 2
- The need for Burnup Credit is beyond actinide-only
- Staff is currently working on ISG-8, Rev.3 which addresses Burnup Credit beyond actinide-only

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Burnup Credit (cont.)

- ISG 8, Rev. 3 will address:
  - the fission product benchmarking
  - parameters affected with actinide+fission product credit
  - Alternatives to burnup verification measurements

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Summary

- High payload transport casks pushing the criticality safety envelope
- Storage casks not designed originally to meet criticality safety requirements for transport
- Developing guidance for Burnup Credit beyond actinide-only