Design Goals and Interrelationship among Core Design Parameters

Course 22.39, Lecture 2

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Major Design Choices

	PWR	GFR
Coolant	Water	He or SCO_2
Neutron Spectrum Fuel	Thermal	Fast
Fuel	UO_2	Dispersion in Matrix CERCER (U-TRU) C/SiC
Decay Heat Removal System	• Active (Gen II) • Passive (AP1000 and ESBWR)	Active or Passive
Power Conversion Cycle	Rankine	Brayton with Supercritical CO_2 Or Helium

Principle PWR Design Challenges

#1 Reduction of Capital Cost

Design Approaches:

- Constructability
  - Modularity, Informatics, Construction Techniques
- Design Approach
  - Safety by Natural Phenomena
  - Unique Approaches
    - Filtered, Vented Containment
    - Containment in Cooling Tower
    - Steam Generators outside Containment
    - Rapid Refueling Technology

#2 Reduction in O&M Cost

Design and Management Objectives:

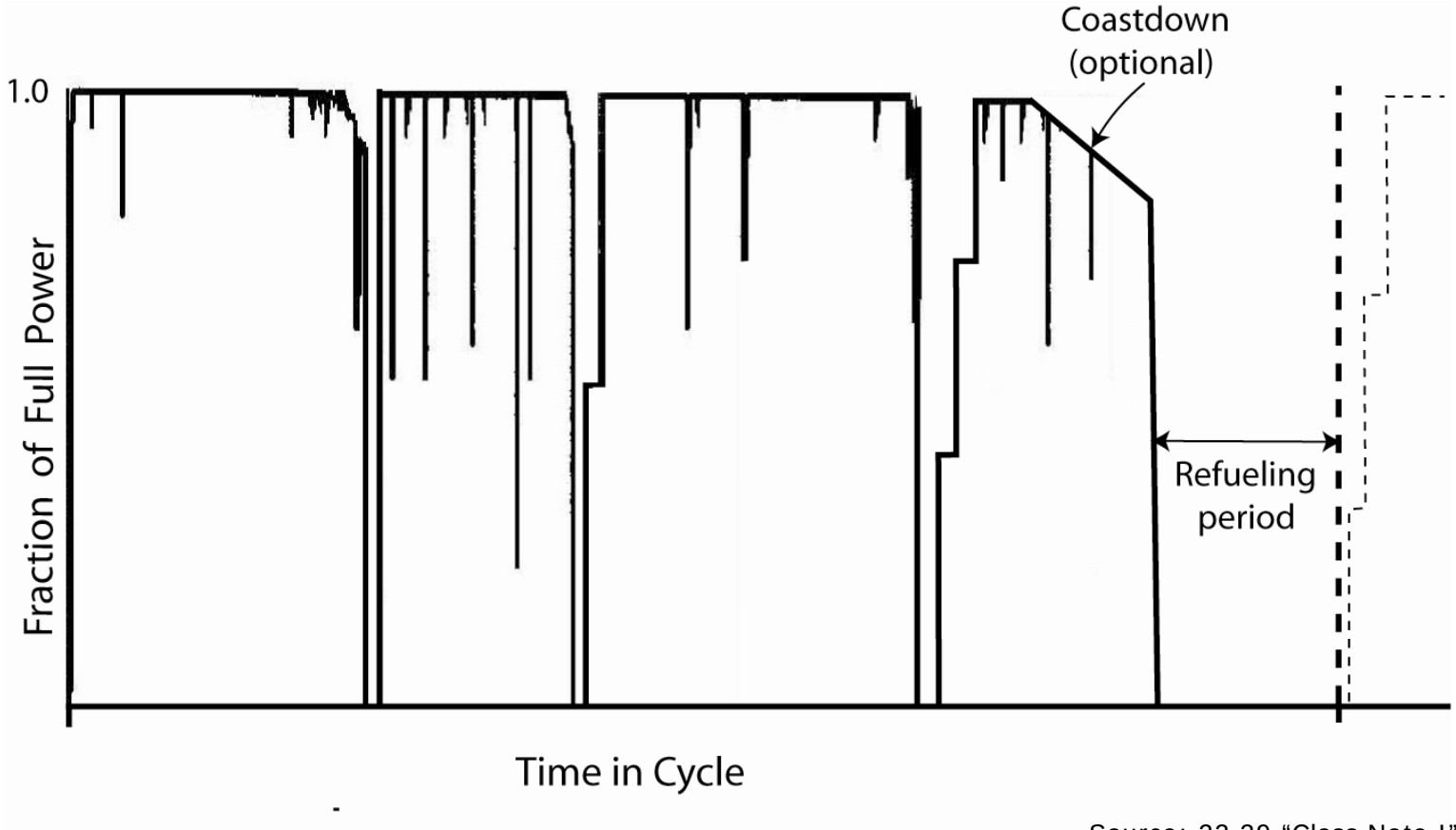
- Reduce Operator Burden
- Reduce Plant Operating Staff

#3 Reduce Spent Fuel Inventory (holding fuel cycle cost level)

Design Approaches

- Increase Fuel Burnup
- Increase Plant Thermal Efficiency
- Separation of Actinides
- Reprocessing of Actinides

Typical Nuclear Plant Operating History

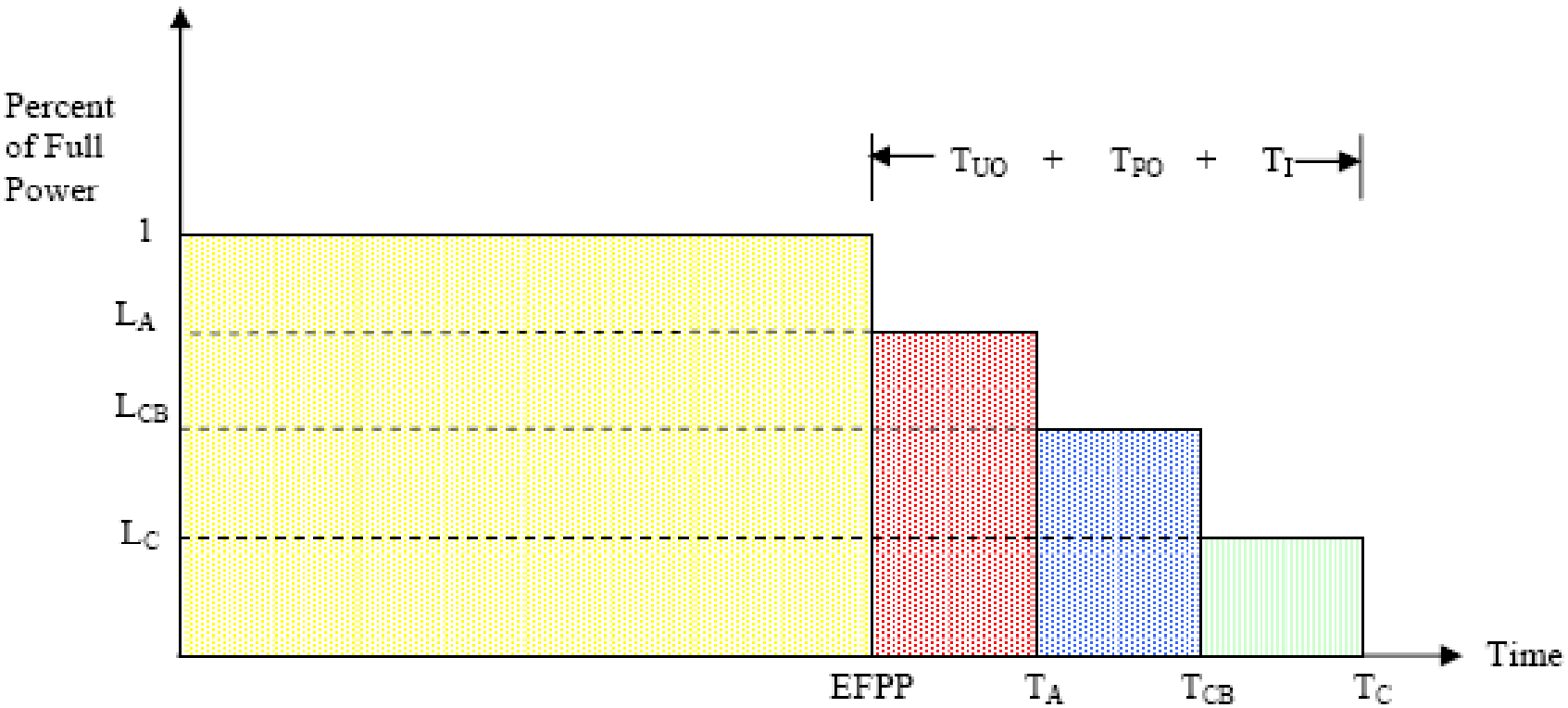


Source: 22.39 “Class Note I”

Time Periods in an Operating Cycle

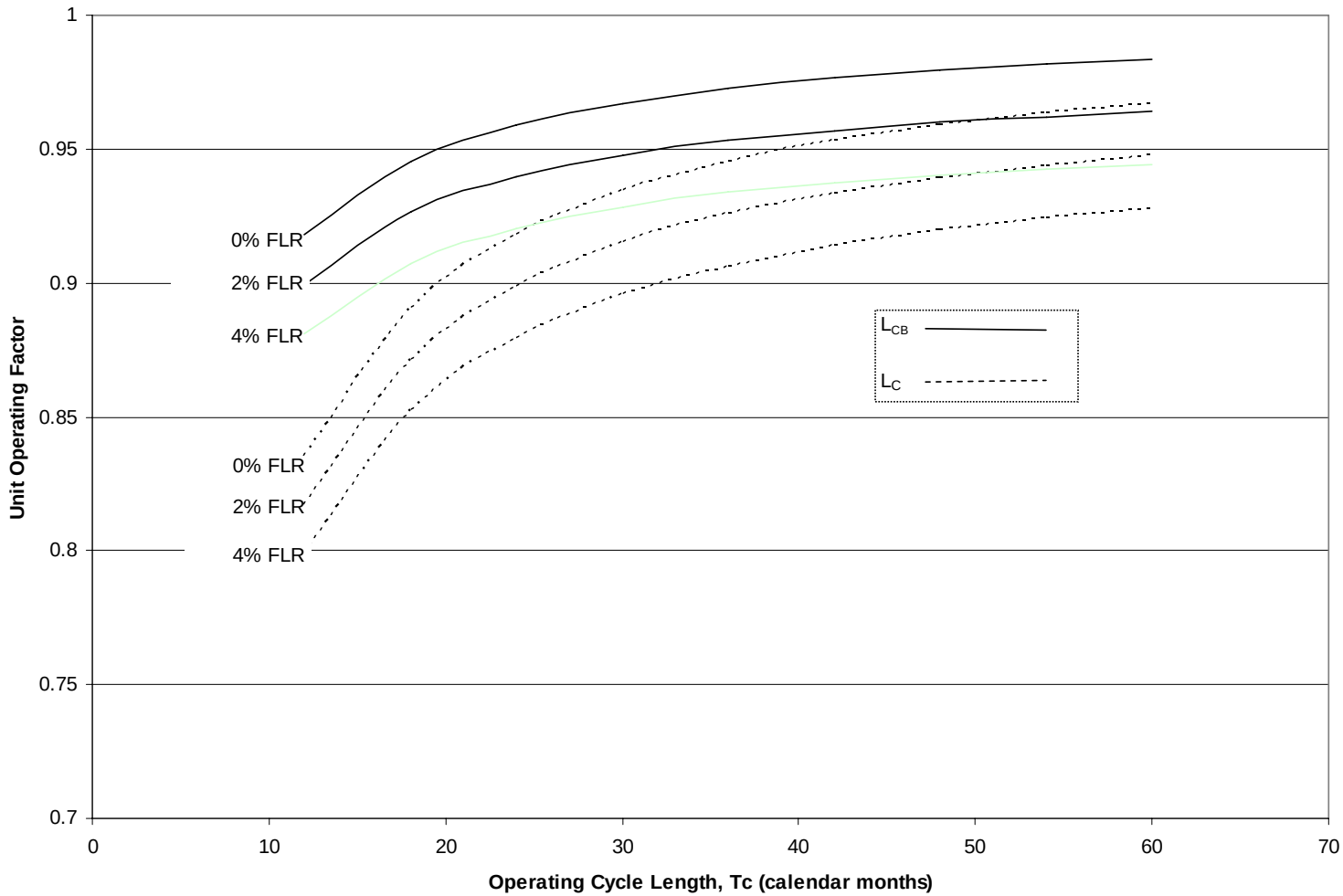
Operation	Outages within Operator Control				Outages outside Operator Control
At Power	Unplanned Outages (UO) T_{UO}		Planned Outages (PO) T_{PO}		Idle Outages (I)
Effective Full Power Period, EFPP	Outage Extension (EO) T_{EO}	Forced Outage (FO) T_{FO}	Refueling Outage (RO) T_{RO}	Maintenance Outage (MO) T_{MO}	T_I

Plant Operating Characteristics



Source: 22.39 "Class Note I"

Effect of Cycle Length on Plant Operating Factors (assuming a 30 day refueling outage length, T_{RO}) and 30 Day Idle Time Period, T_I, outside the Plant Operator's Control



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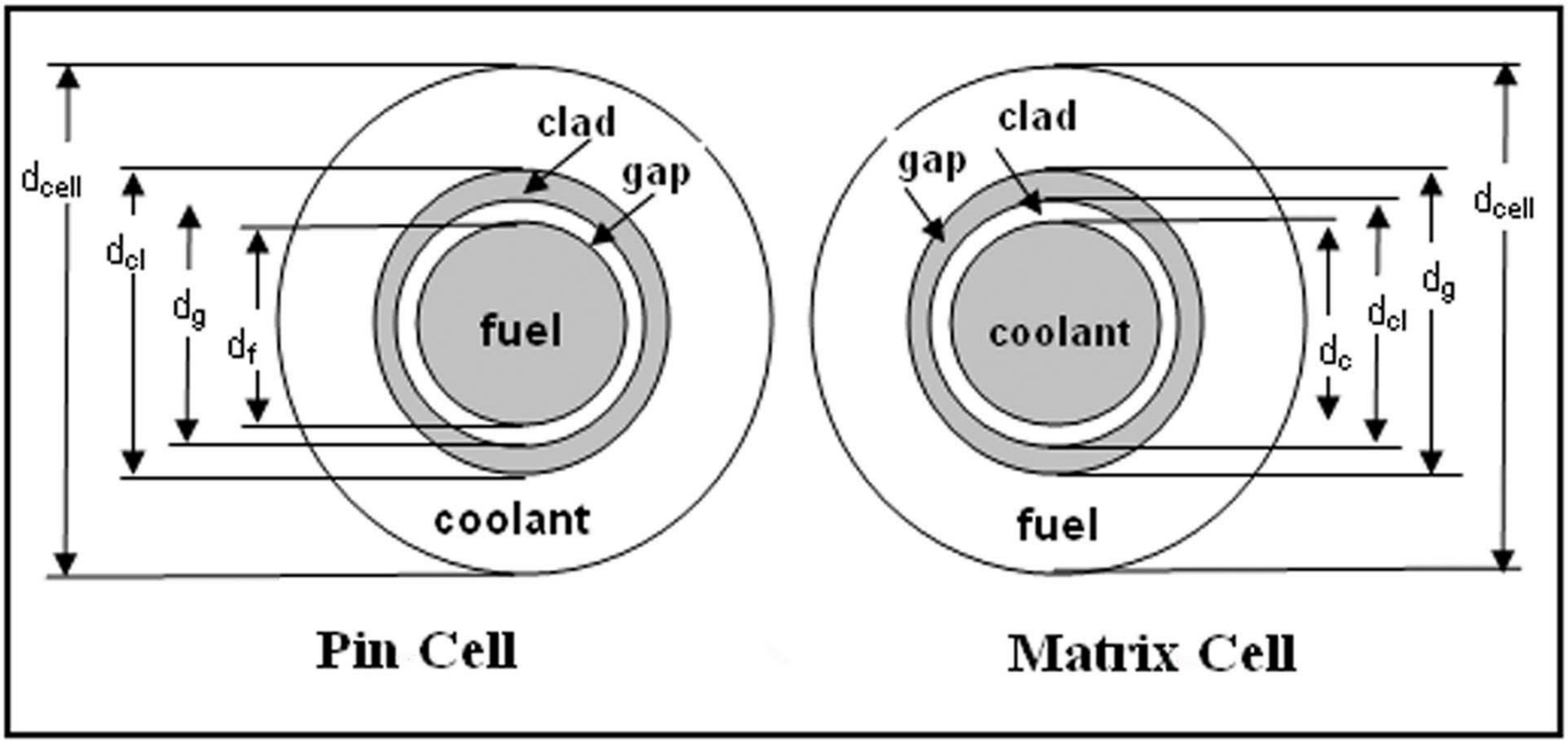
Equivalent Annulus Representation of the pin cell geometry and the inverted or matrix cell geometry



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