UNENE Graduate Course
Reactor Thermal-Hydraulics Design and Analysis

McMaster University
Whitby
March 11-12, March 25-26,
April 8-9, April 22-23, 2006

Introduction

Dr. Nik Popov

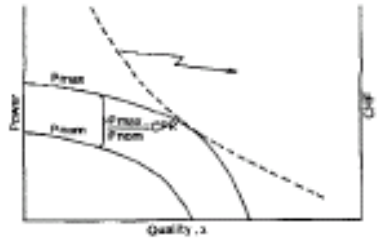
Introduction to TH Design

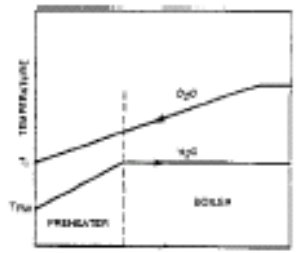
- Course focused on TH design of the reactor core and heat transport system, and interrelated
  - systems, such as steam generators, turbines, etc., and
  - components, such as valves, pumps, pipes, heat exchangers, etc.
- Disciplines involved
  - Reactor physics
  - Heat transfer
  - Fluid mechanics
  - Thermodynamics
  - Stress analysis, etc

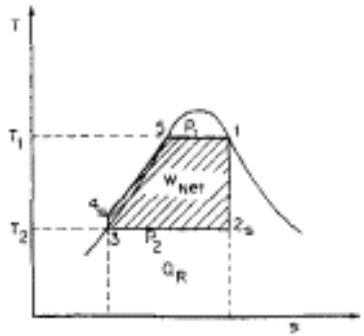
Introduction to TH Design (cont'd)

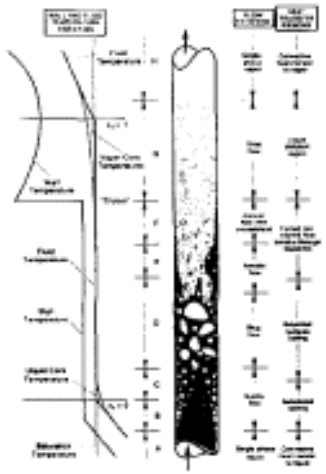
- Important aspects to consider and optimize
  - Safety
  - Cost
  - Material limits (temps, mechanical stress, erosion, corrosion, etc.).
  - Regulations
  - Past experience
  - Standardized design requirements
  - Quality insurance
  - Marketability
- "Good design process is evolutionary"!

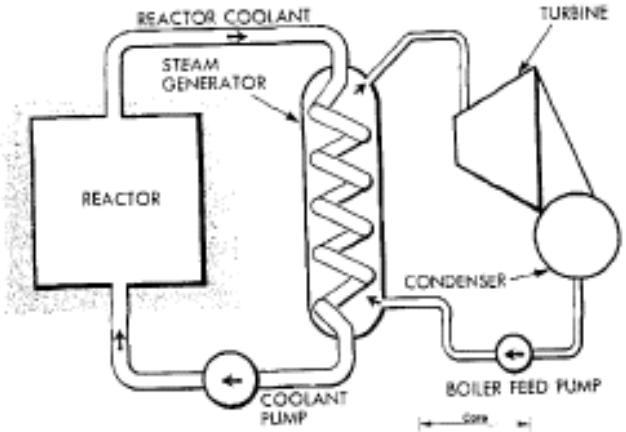
Course Overall Scope Diagram

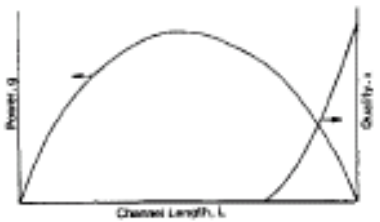


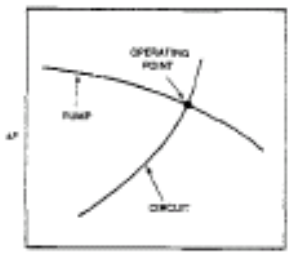


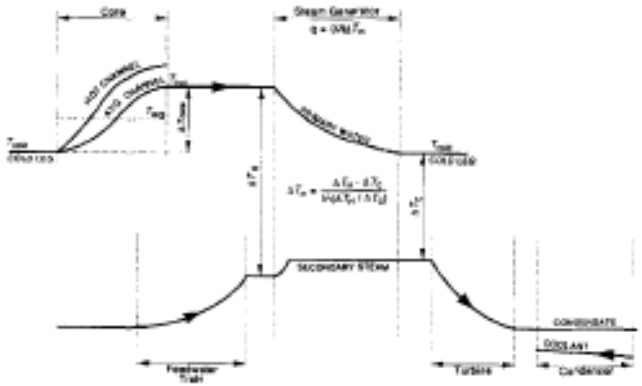












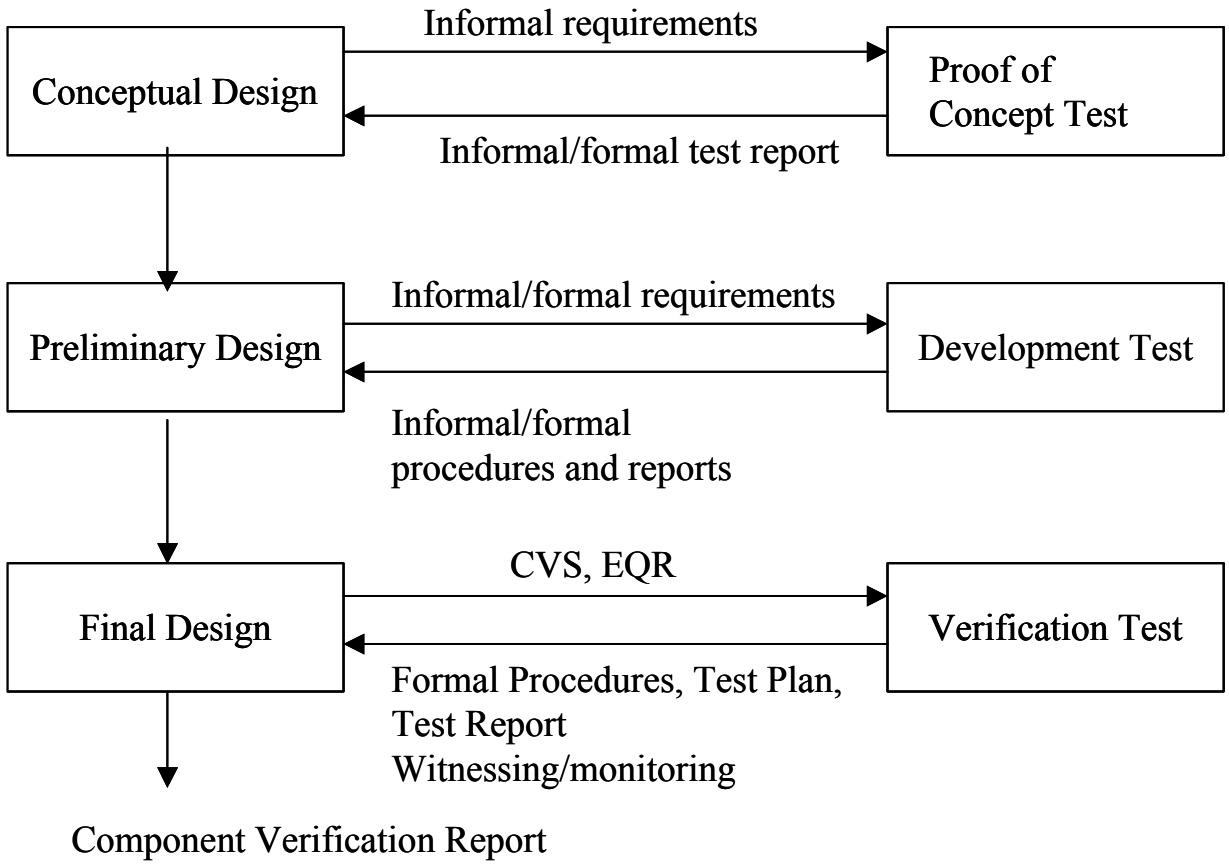
The Design Process

- Design principles
  - Establish improved design practices
  - Take into account feedback from previous designs
  - Design more margins into the new designs
- Design methods
  - Analysis concepts
  - Design guides
  - Design tools
  - Verification
  - Training of staff
- Design Development

The Design Process (cont'd)

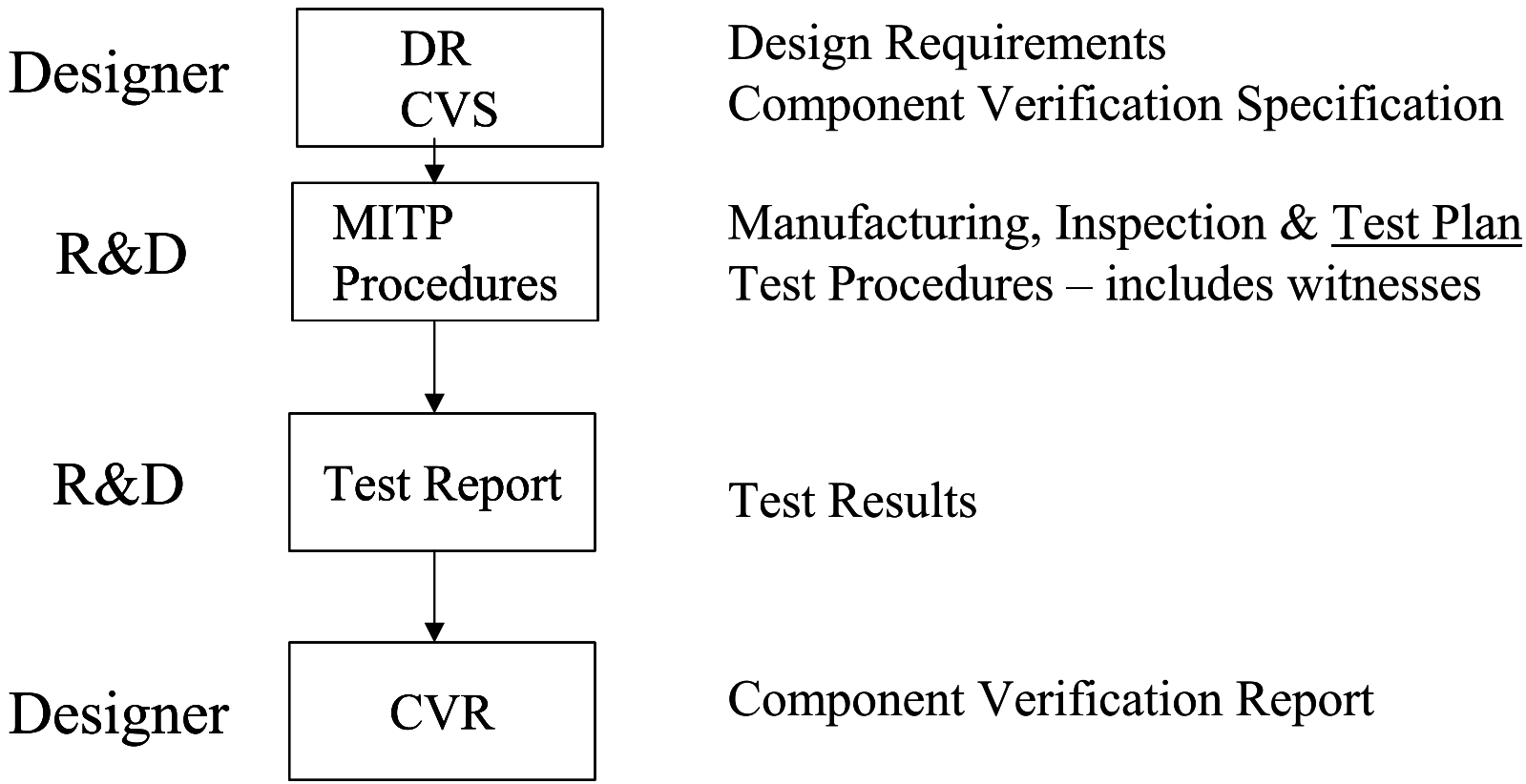
- Design Development
  - Identify specific correlations and methodologies
  - Perform laboratory testing
  - Take into account feedback from sites
- Design
  - Establish main ground rules
  - Optimize design
  - Interaction between different design groups and disciplines
- Produce design documents
  - Design Requirements (DR)
  - Design Description (DD)
  - Design Manuals (DM)
  - Technical Descriptions (TD)
  - Generic Design Deviations (GDD)
  - Commissioning Procedures
  - Equipment Dockets

Linkage Between Design and R&D



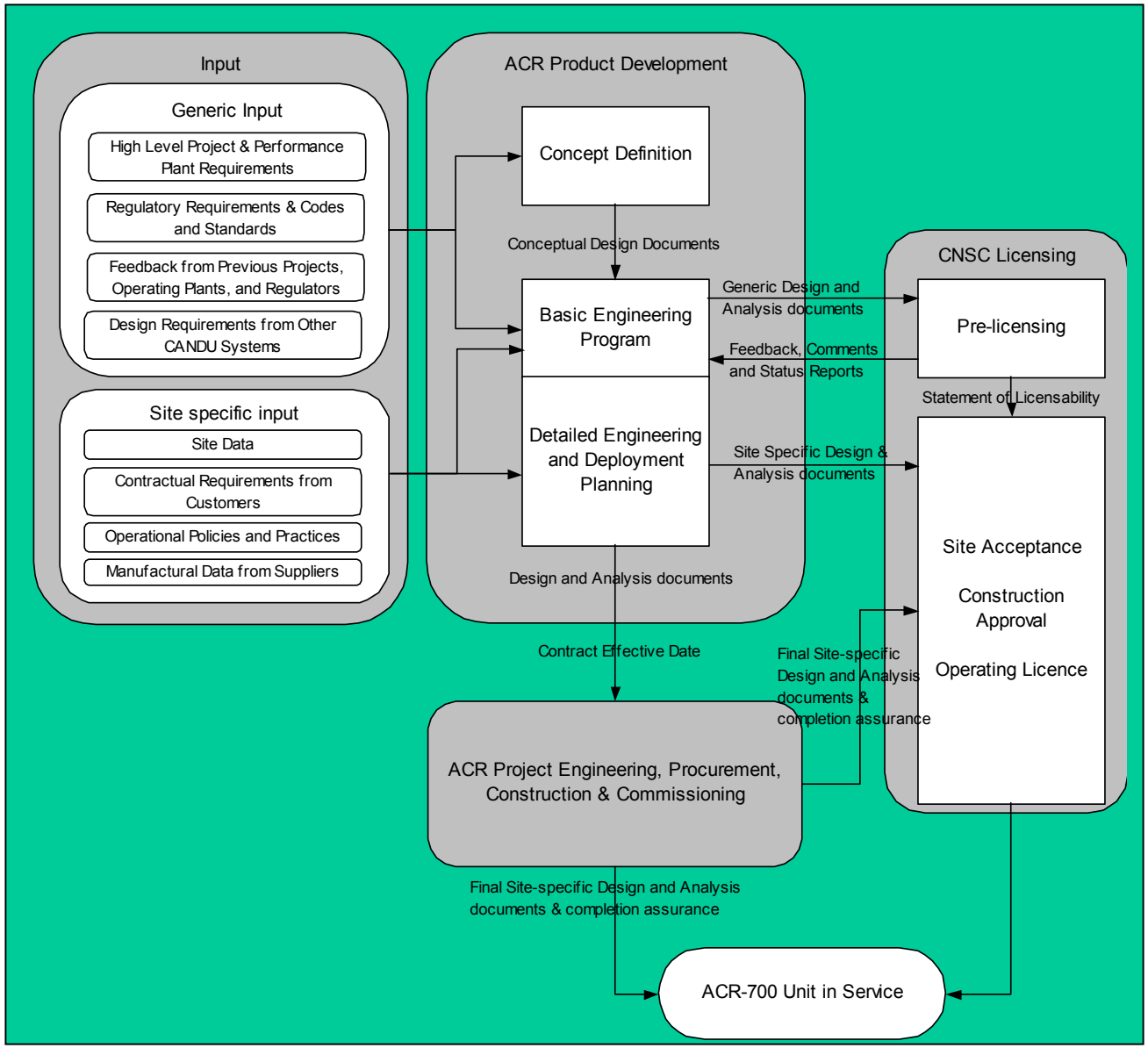
N286.2 Clause 6

Design Verification Process

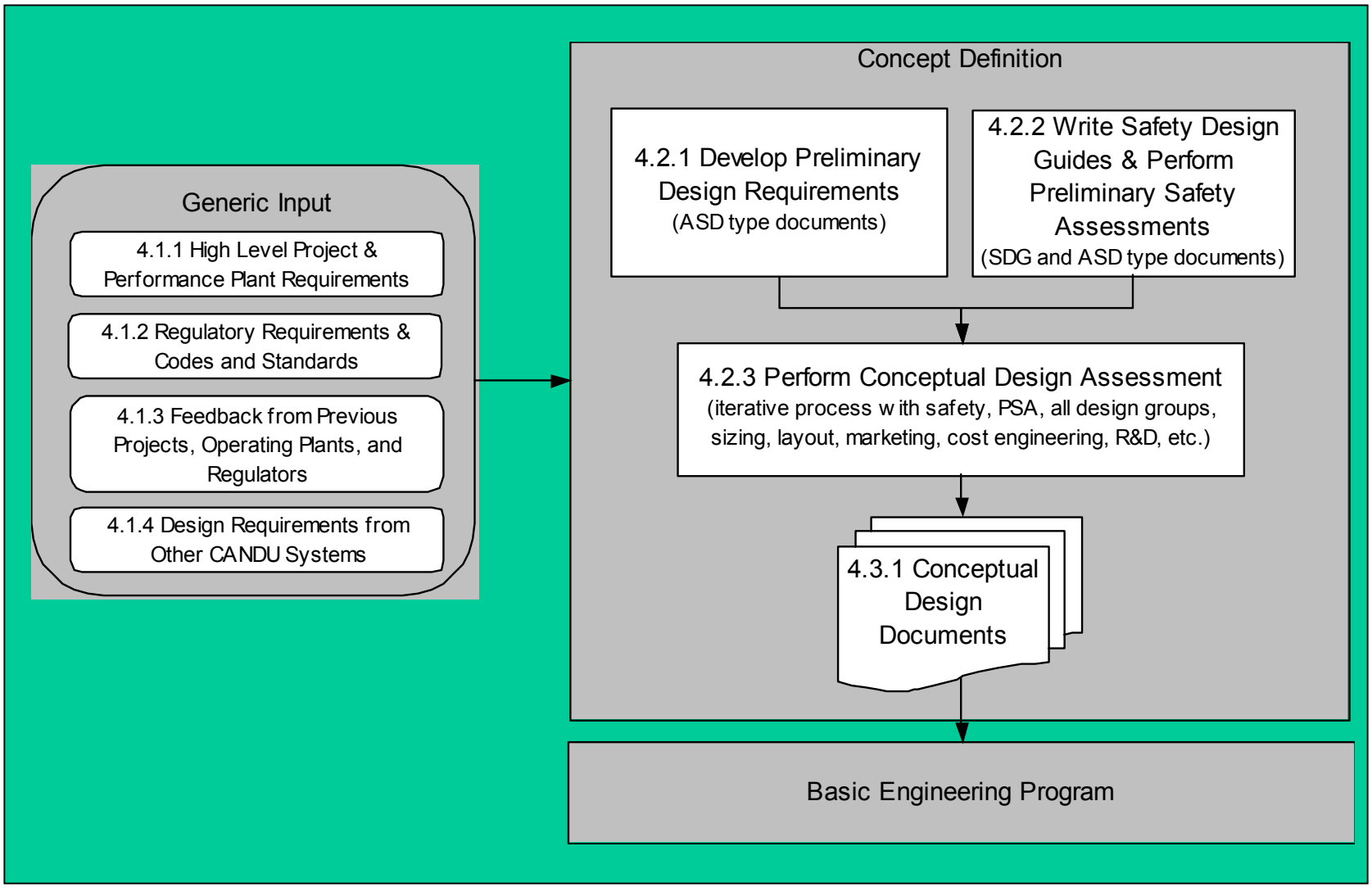


Verification Testing at AECL carried out under specific procedures to meet N286.2 Clause 6 requirements.

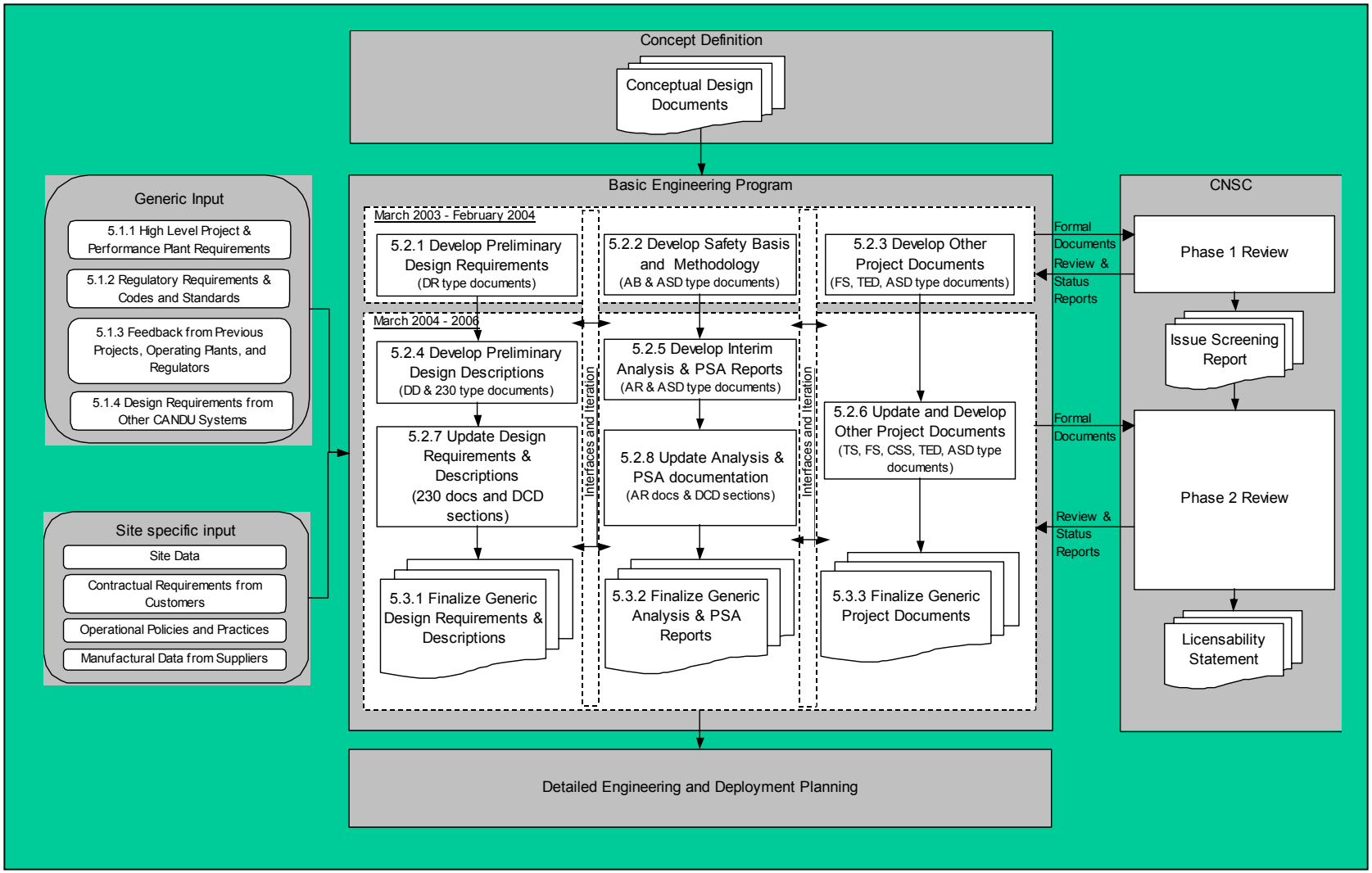
Generic Design Process



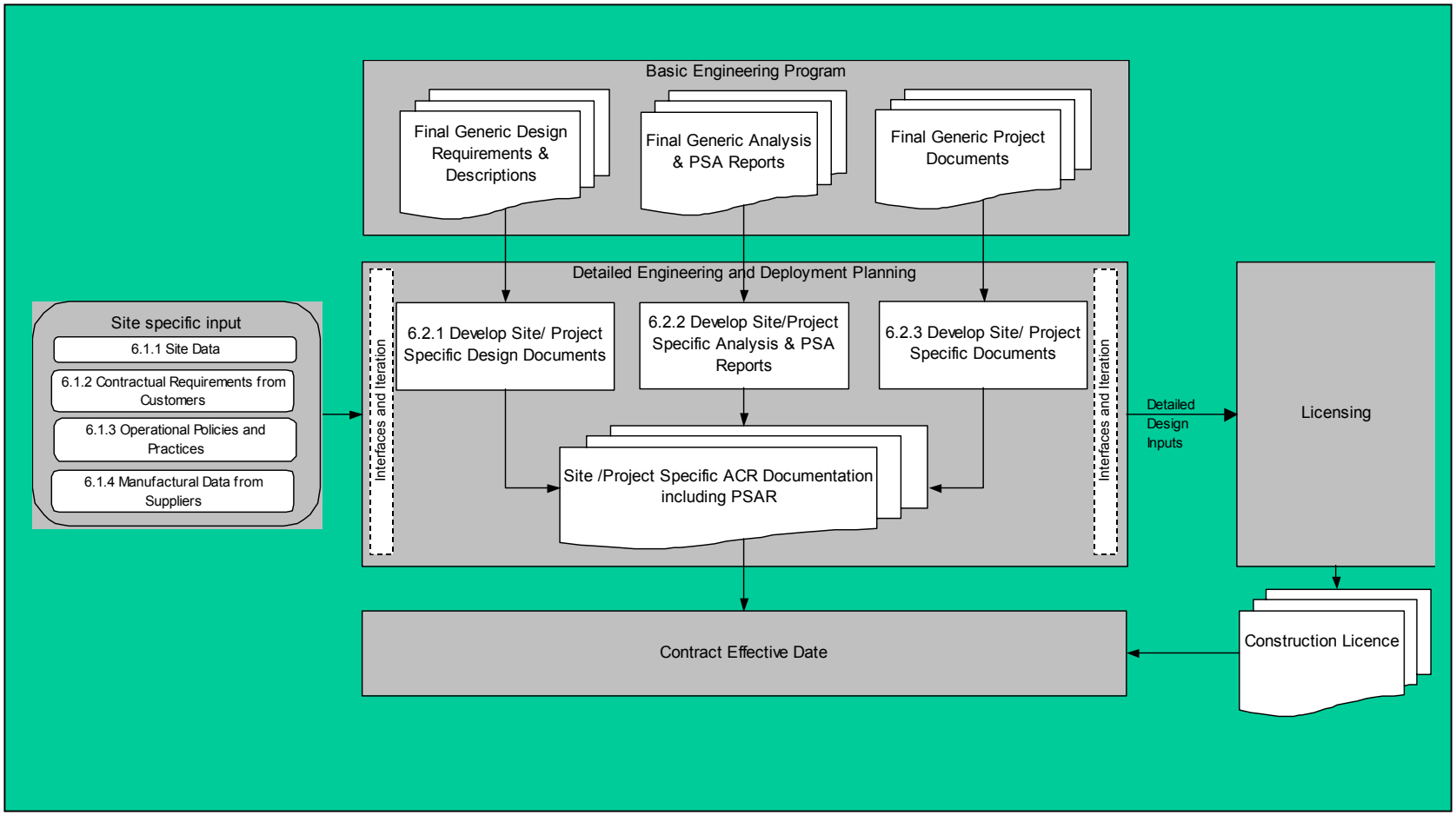
Generic Design Process (cont'd)



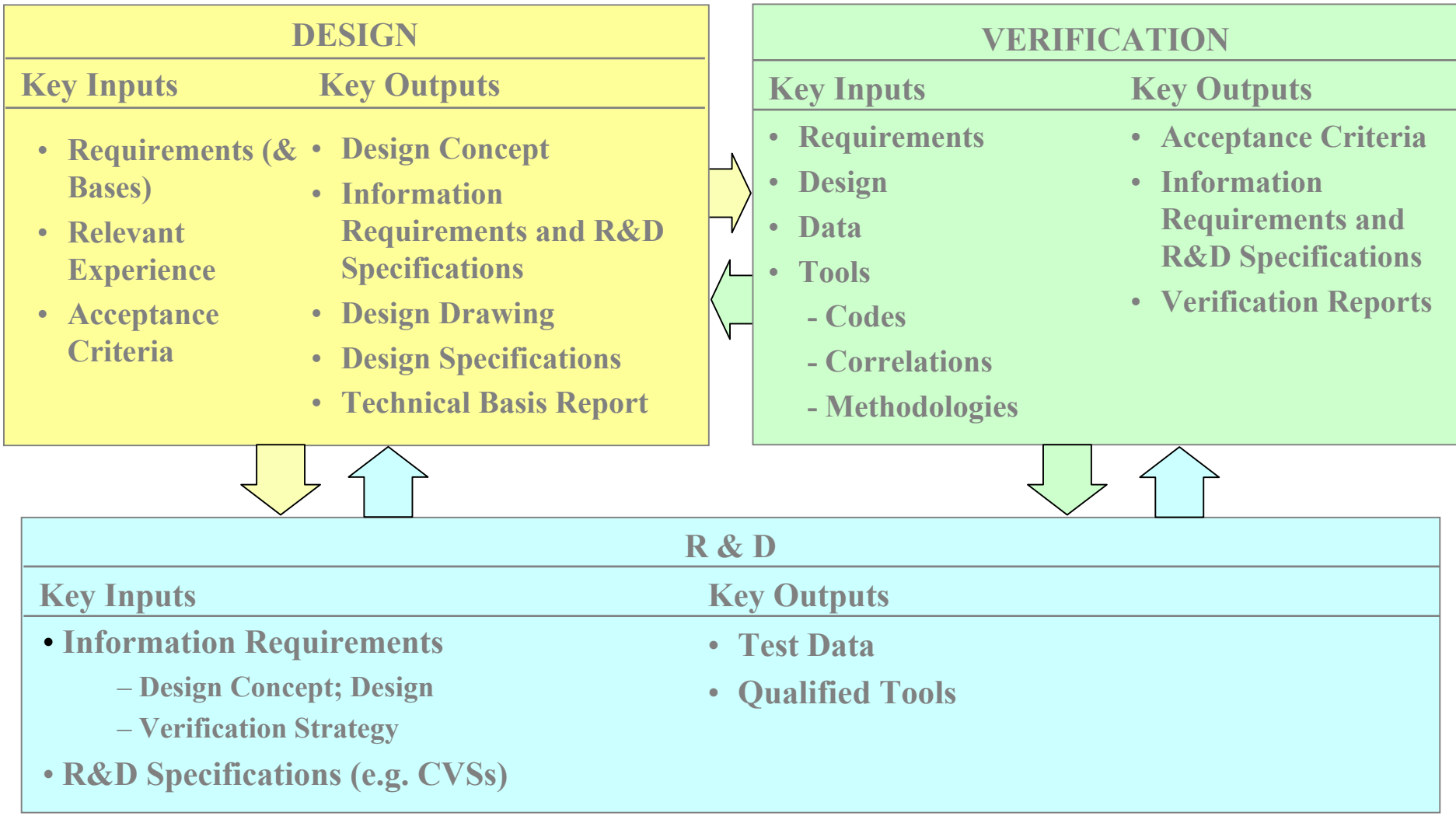
Generic Design Process (cont'd)



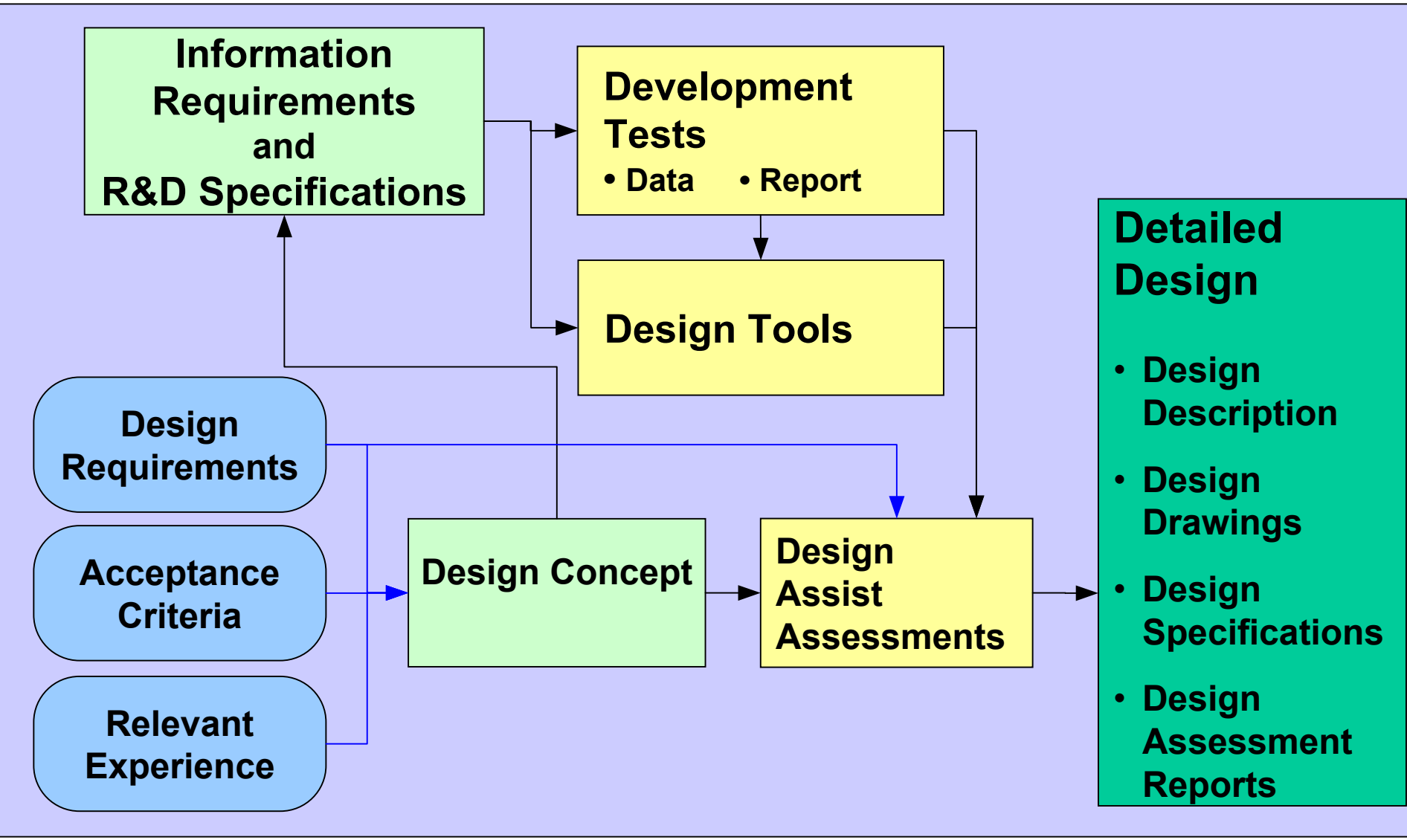
Generic Design Process (cont'd)



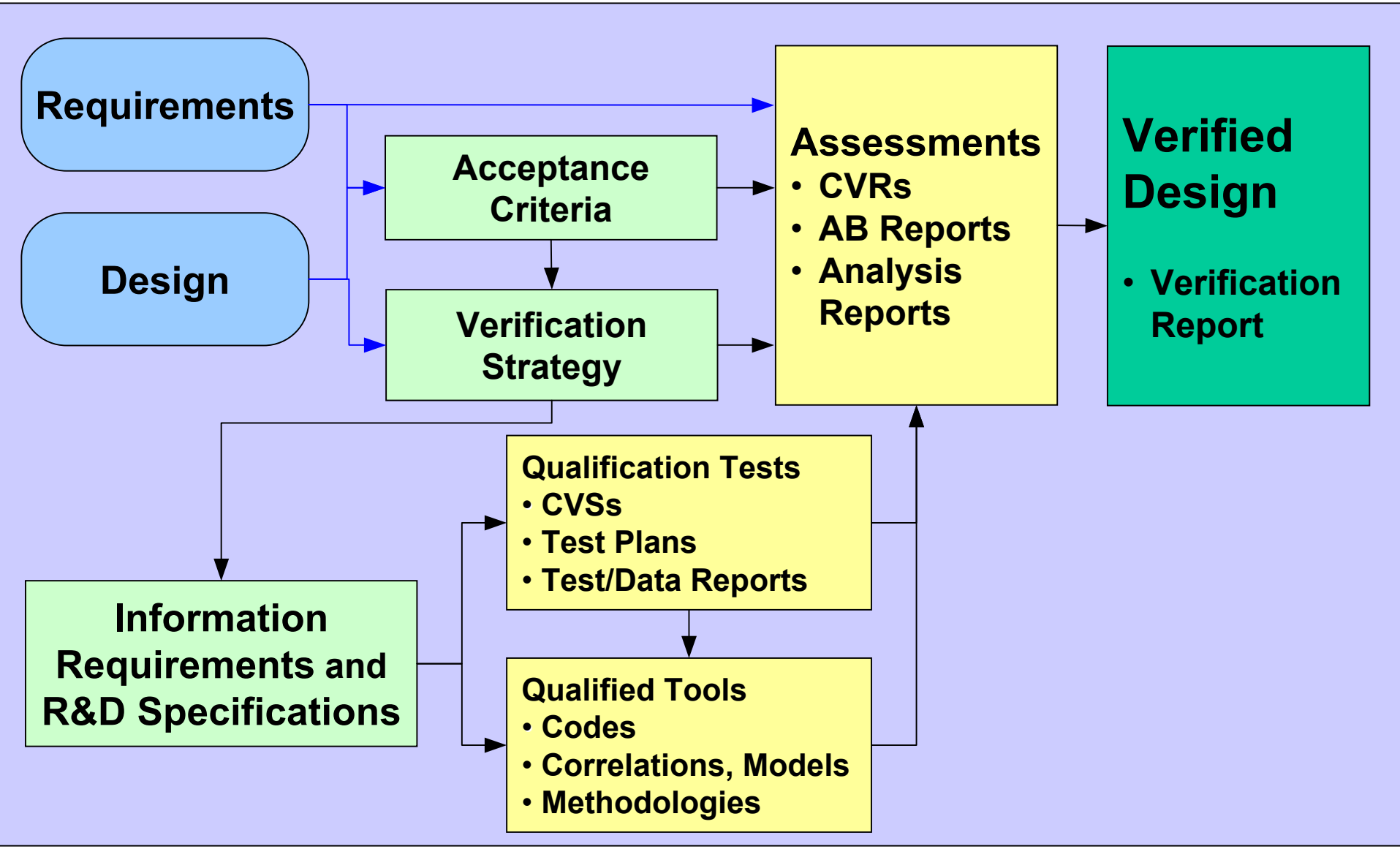
Key Design Activities



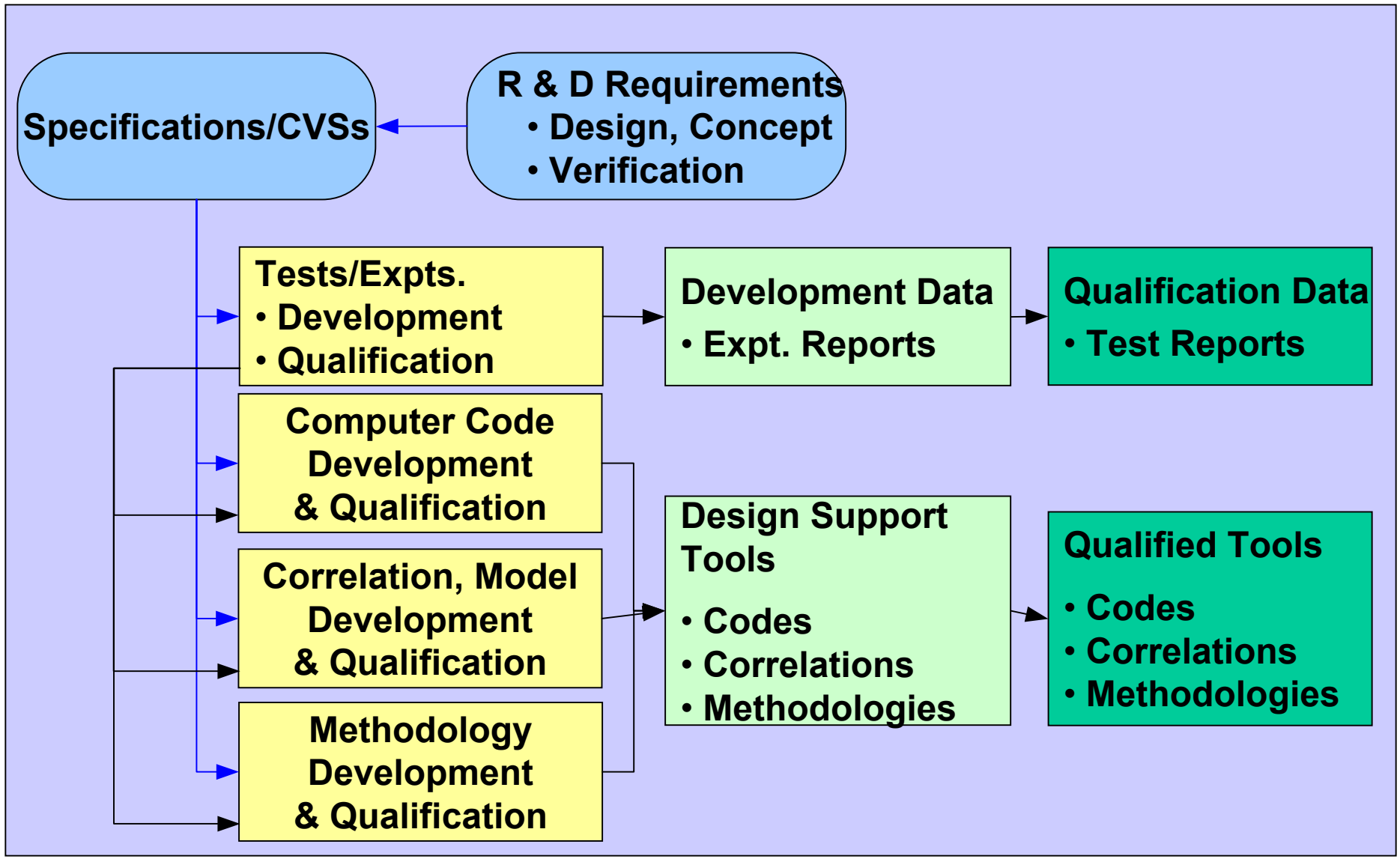
Design Process



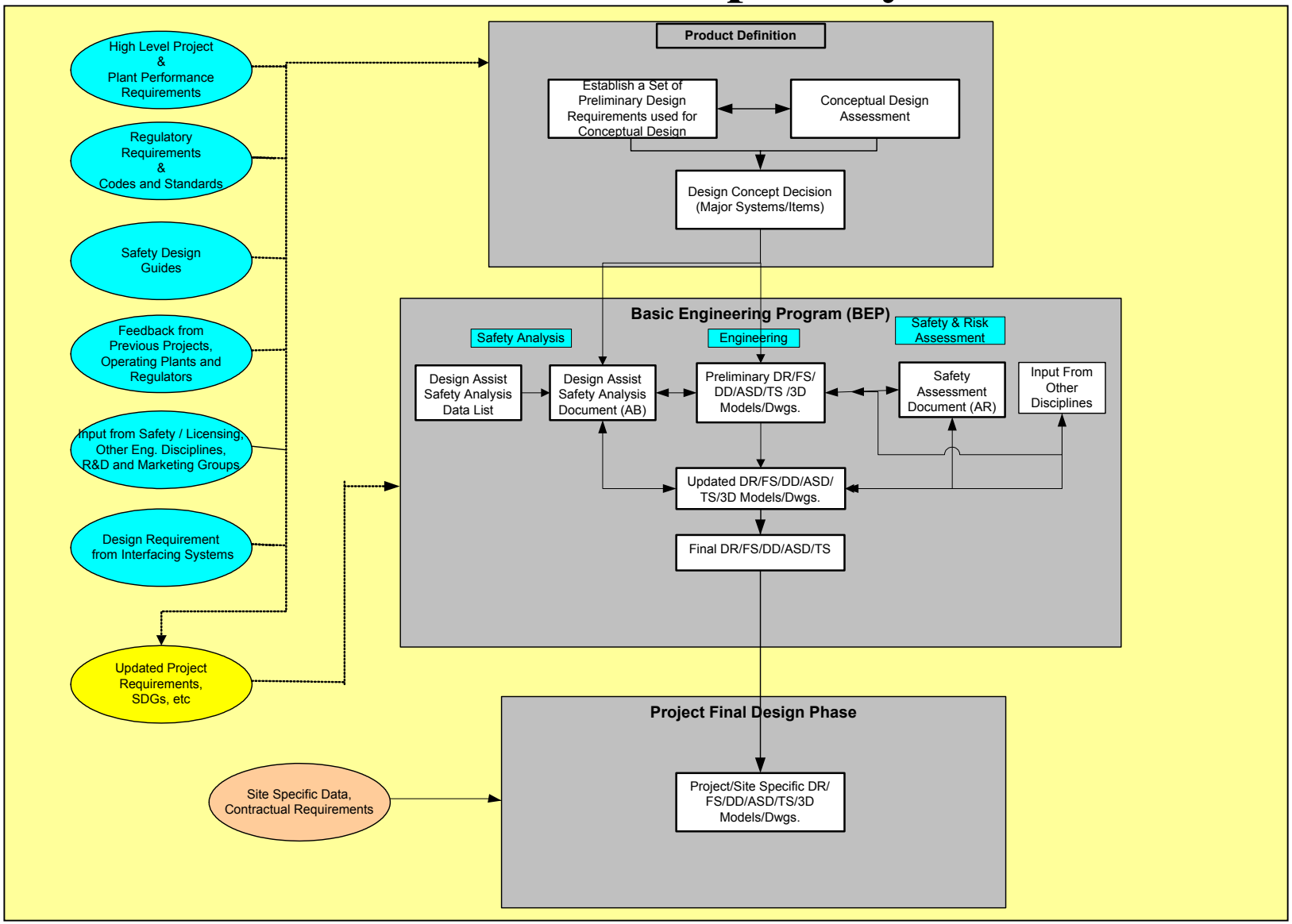
Verification Process



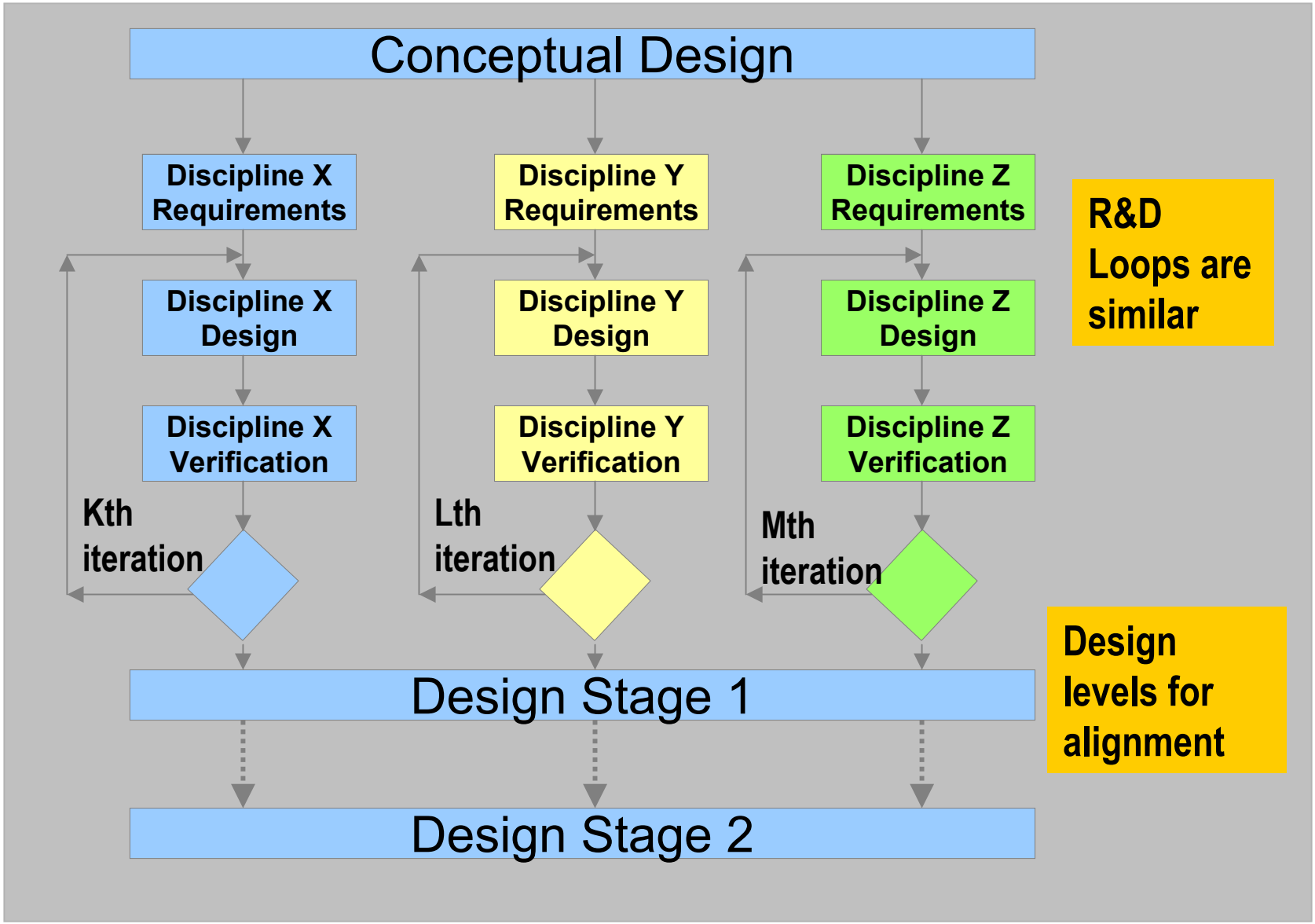
R & D Process


Specifications/CVSs
R & D Requirements
• Design, Concept
• Verification
Tests/Expts.
• Development
• Qualification
Development Data
• Expt. Reports
Qualification Data
• Test Reports
Computer Code Development & Qualification
Correlation, Model Development & Qualification
Methodology Development & Qualification
Design Support Tools
• Codes
• Correlations
• Methodologies
Qualified Tools
• Codes
• Correlations
• Methodologies

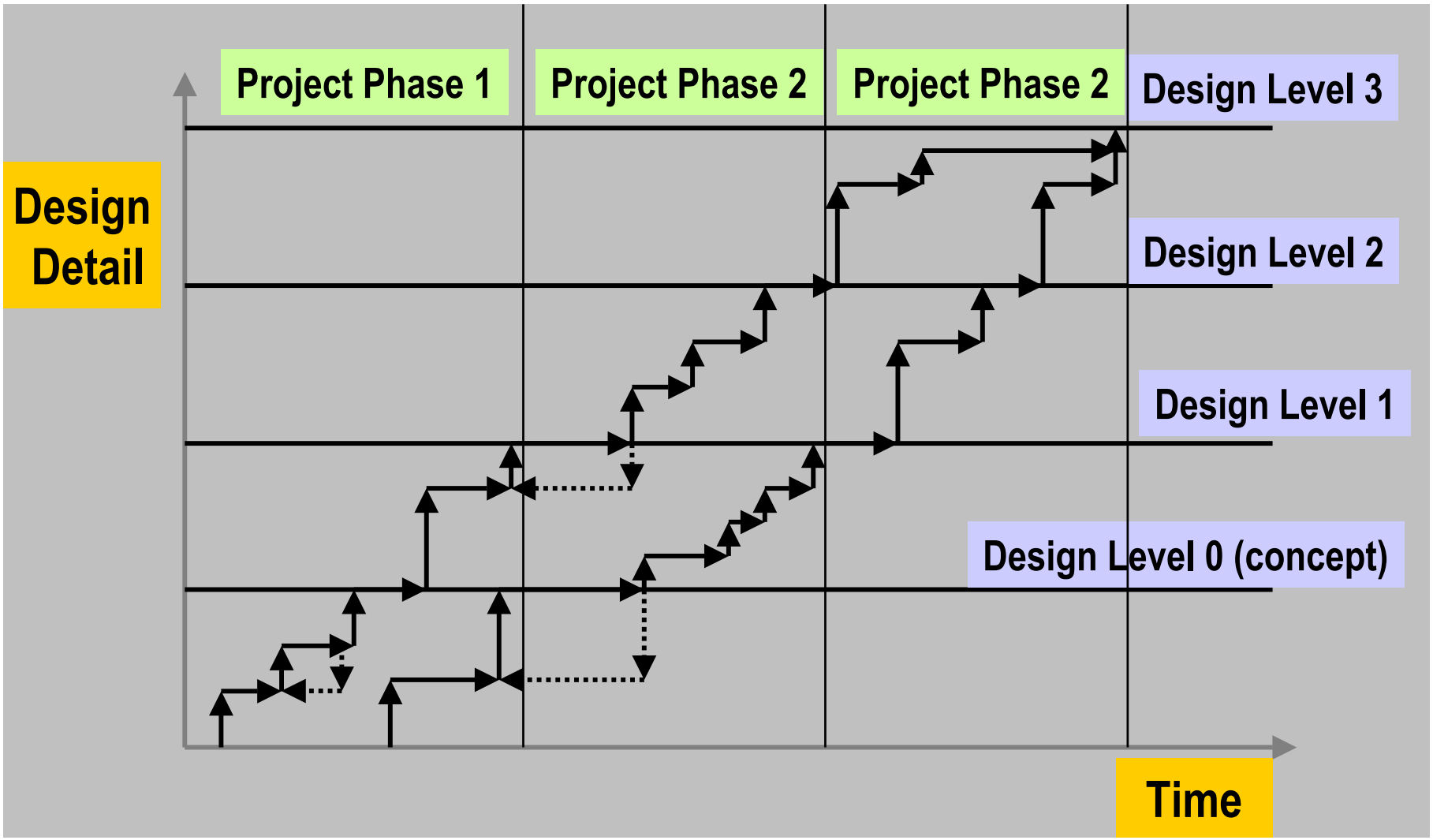
Example of Process for Preparation of Design Documentation & Multidisciplinary Interfaces



Design Iterative Process



Design Process – Cascading Steps



Questions?