UNENE Graduate Course
Reactor Thermal-Hydraulics Design and Analysis
McMaster University
Whitby
## March 19-21, April 23-25, May 2, 2004

Introduction

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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
- "<u>Good design process is evolutionary</u>"!
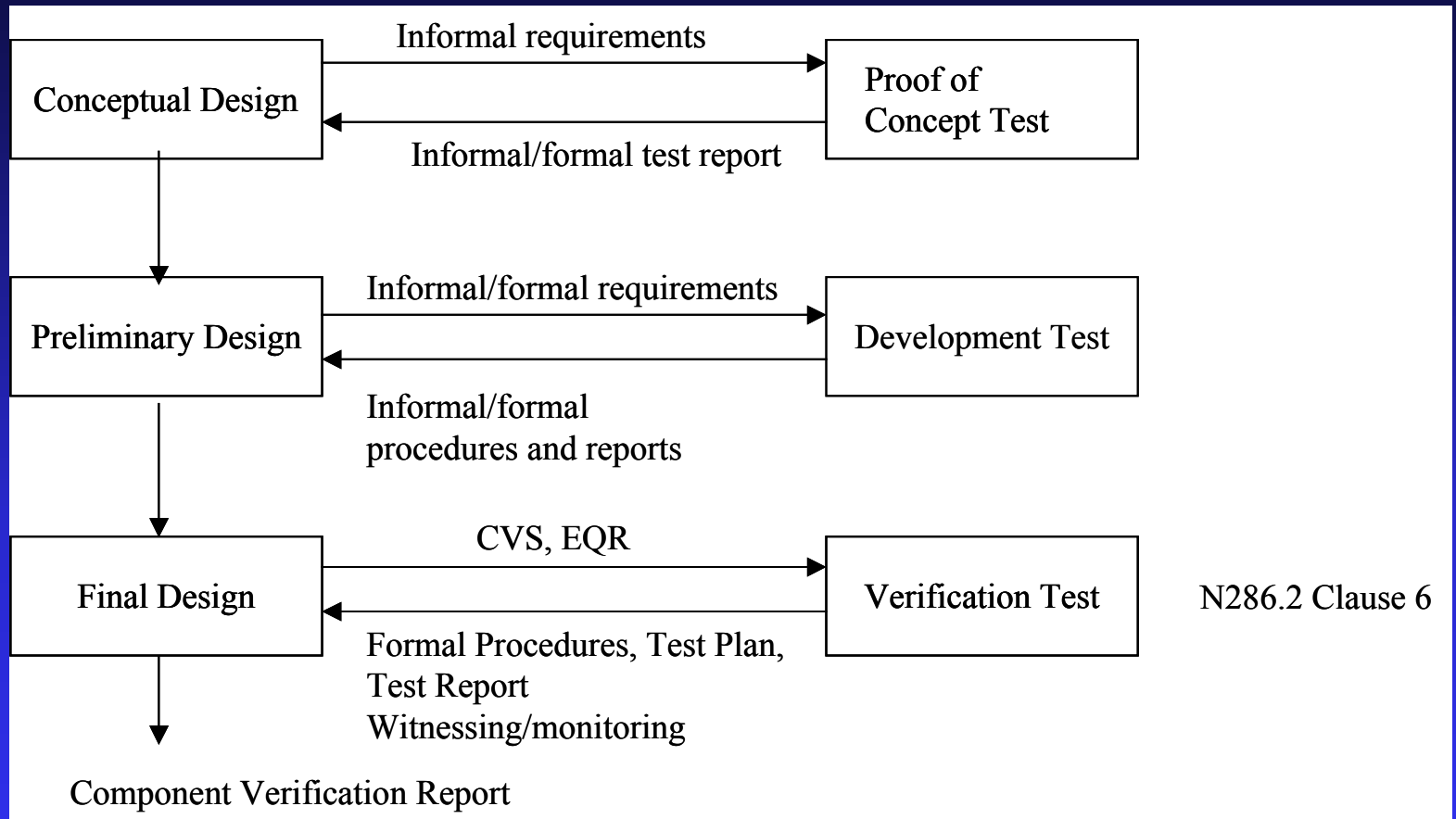
Course Overall Scope Diagram
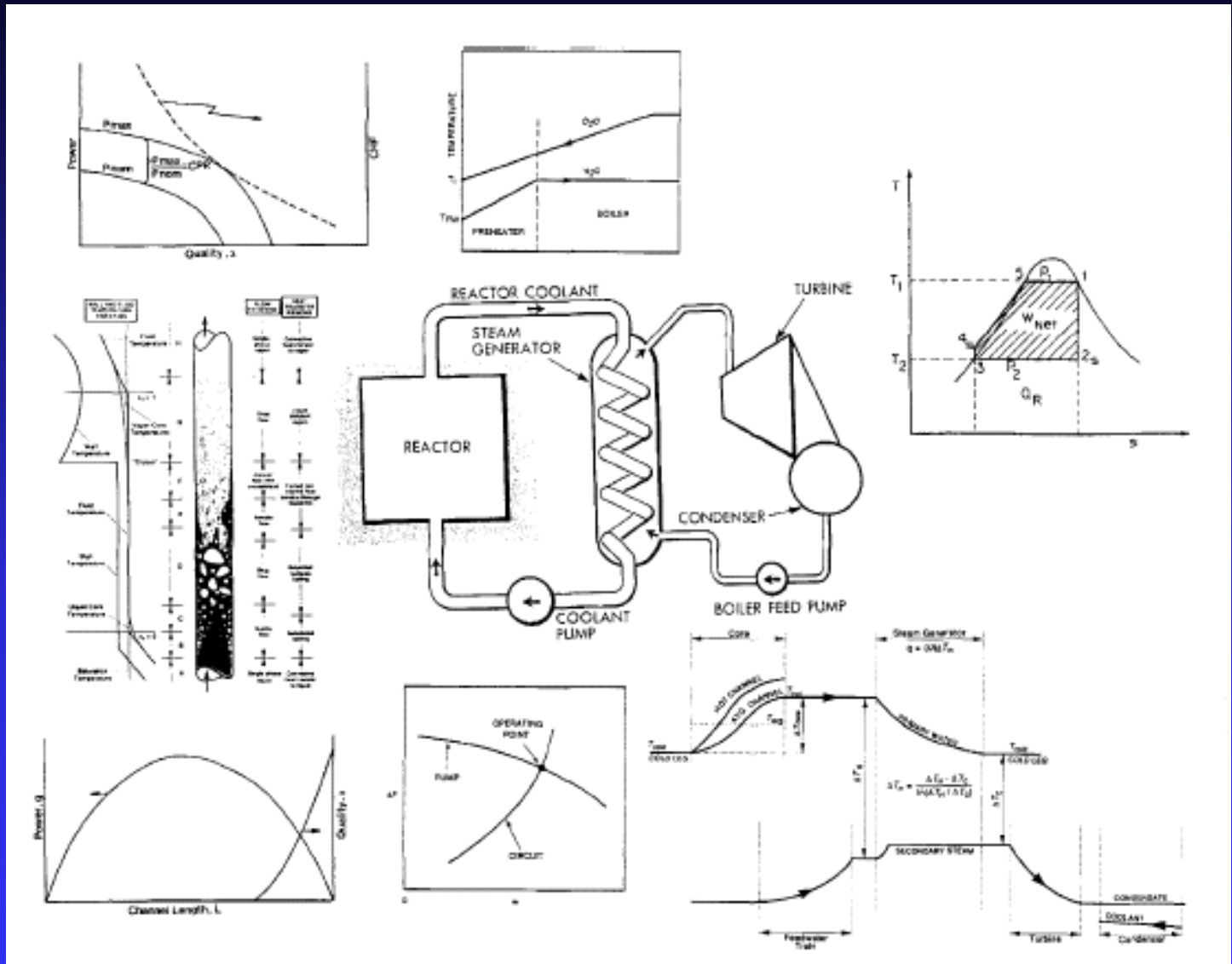
The Design Process

- 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

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  ┌─────────────────┐   Informal requirements    ┌─────────────────┐
  │                 │ ─────────────────────────▶ │ Proof of        │
  │ Conceptual      │                            │ Concept Test    │
  │ Design          │ ◀───────────────────────── │                 │
  └─────────────────┘   Informal/formal test report└───────────────┘
          │
          ▼
  ┌─────────────────┐  Informal/formal requirements ┌────────────────┐
  │                 │ ─────────────────────────▶   │                │
  │ Preliminary     │                              │ Development Test│
  │ Design          │ ◀─────────────────────────   │                │
  └─────────────────┘   Informal/formal           └────────────────┘
          │             procedures and reports
          ▼
  ┌─────────────────┐   CVS, EQR                   ┌────────────────┐
  │                 │ ─────────────────────────▶   │                │   N286.2 Clause 6
  │ Final Design    │ ◀─────────────────────────   │ Verification Test│
  └─────────────────┘   Formal Procedures, Test Plan,└──────────────┘
          │             Test Report
          ▼             Witnessing/monitoring

  Component Verification Report
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Design Verification Process

Designer	DR CVS	Design Requirements Component Verification Specification
R&D	MITP Procedures	Manufacturing, Inspection & <u>Test Plan</u> Test Procedures – includes witnesses
R&D	Test Report	Test Results
Designer	CVR	Component Verification Report
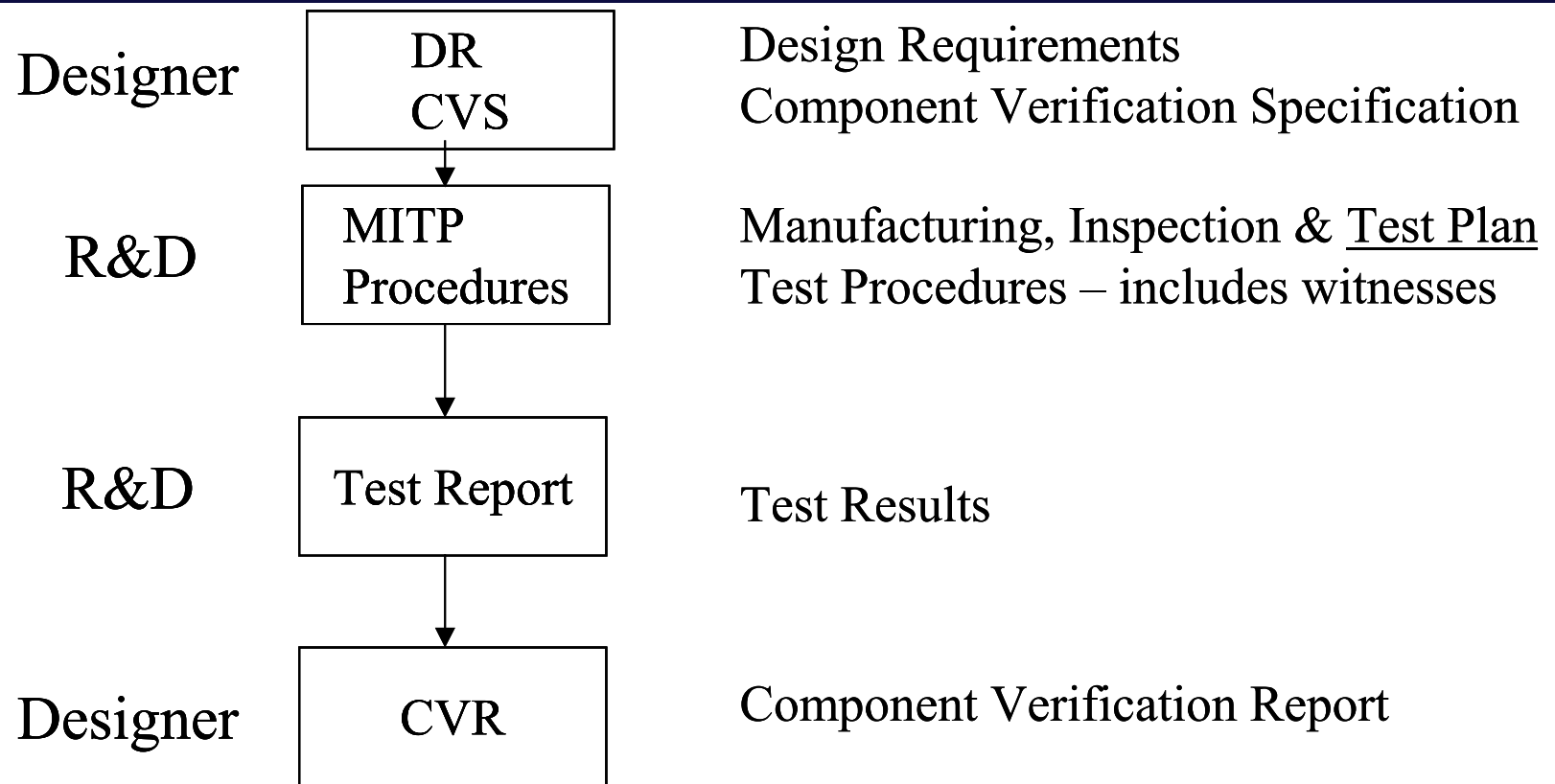
Verification Testing at AECL carried out under specific procedures to meet N286.2 Clause 6 requirements.