Reactivity Mechanisms

Reactivity Control

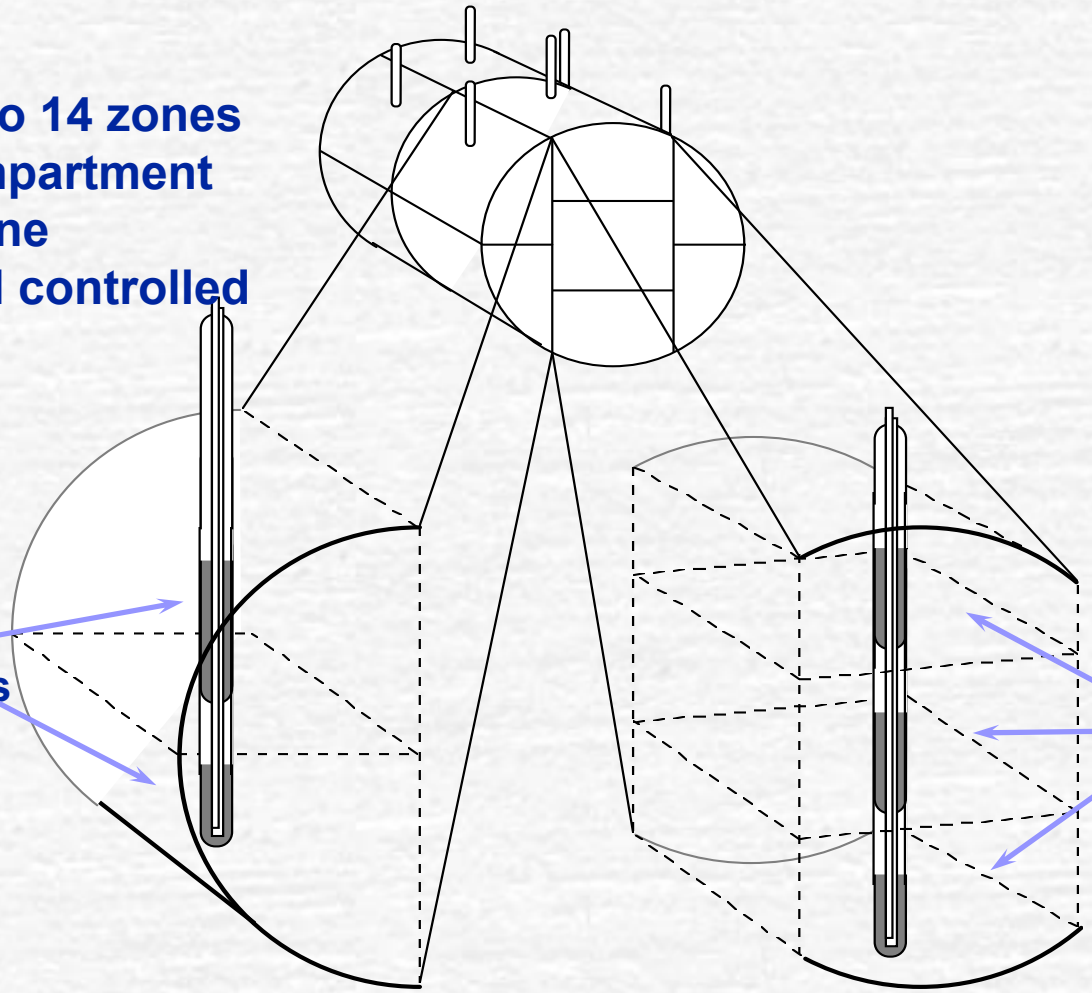
- Two general functions
  - reactor power regulation
  - reactor protection

Reactor Control

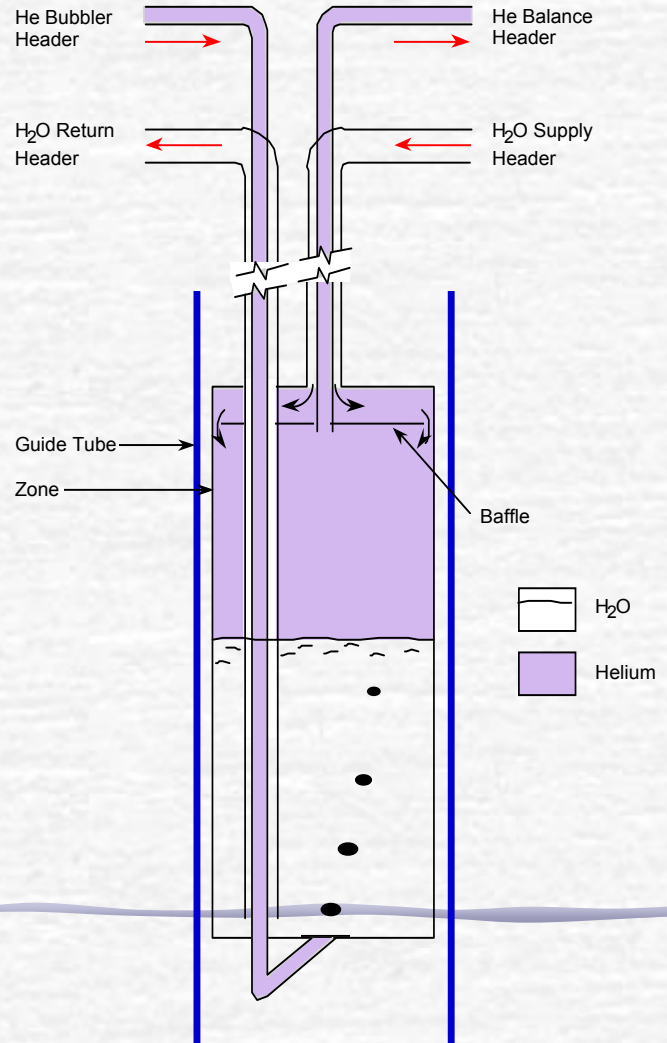
Liquid Zones

Reactor

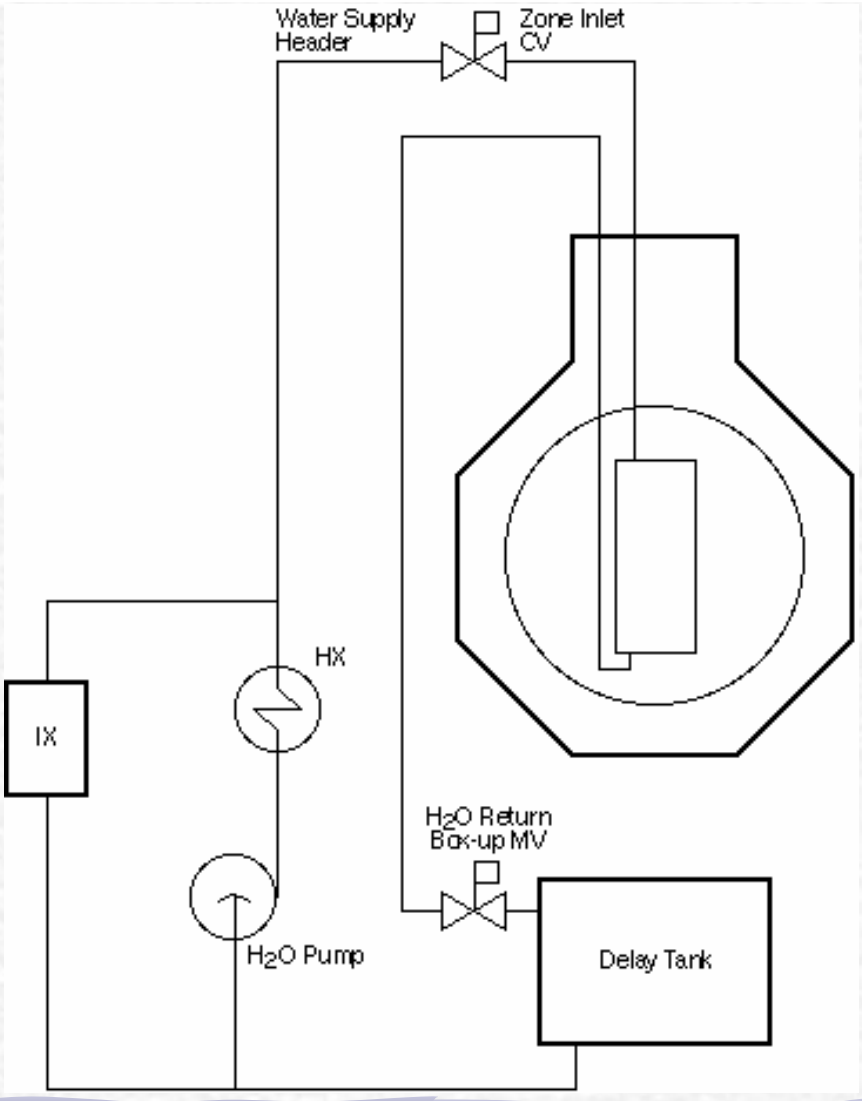
- Divided into 14 zones
- Liquid compartment in each zone
- Water level controlled



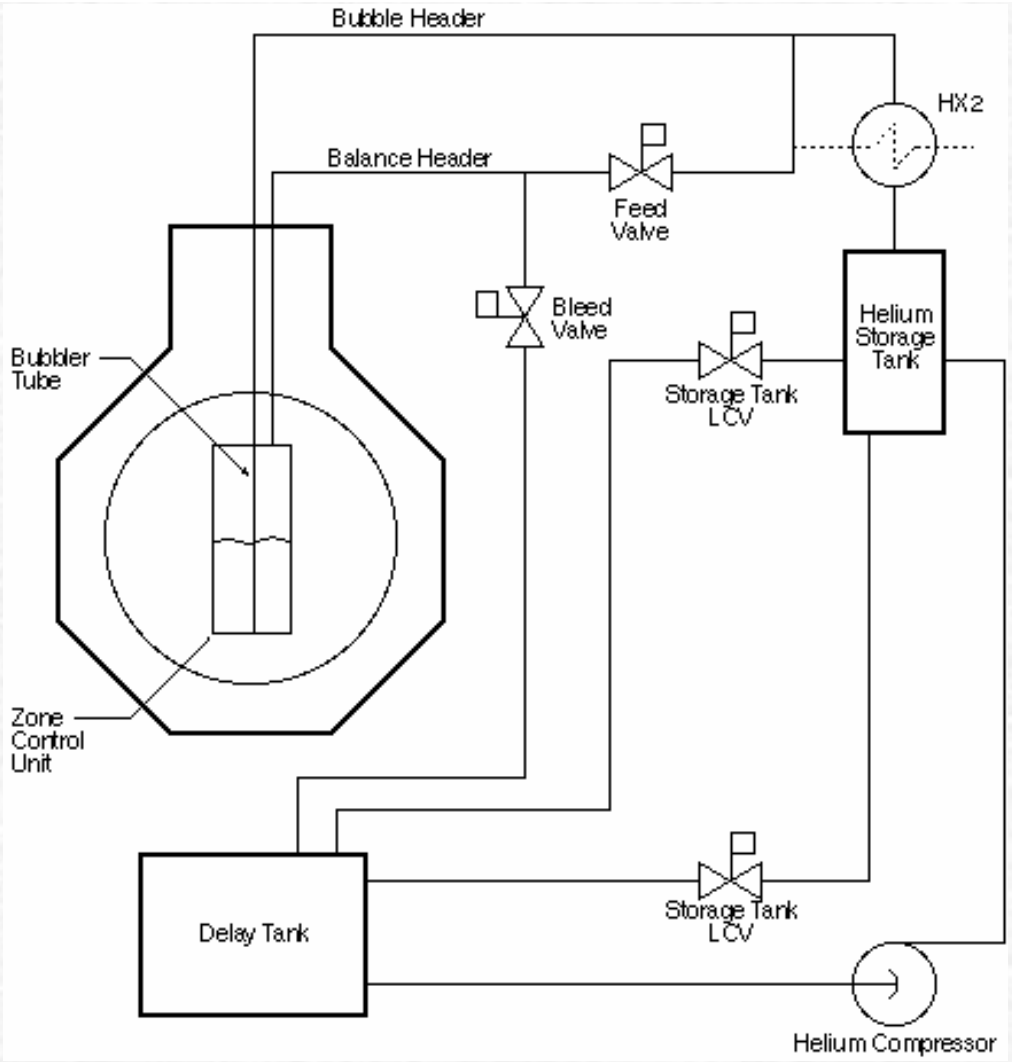
Simplified Liquid Zone

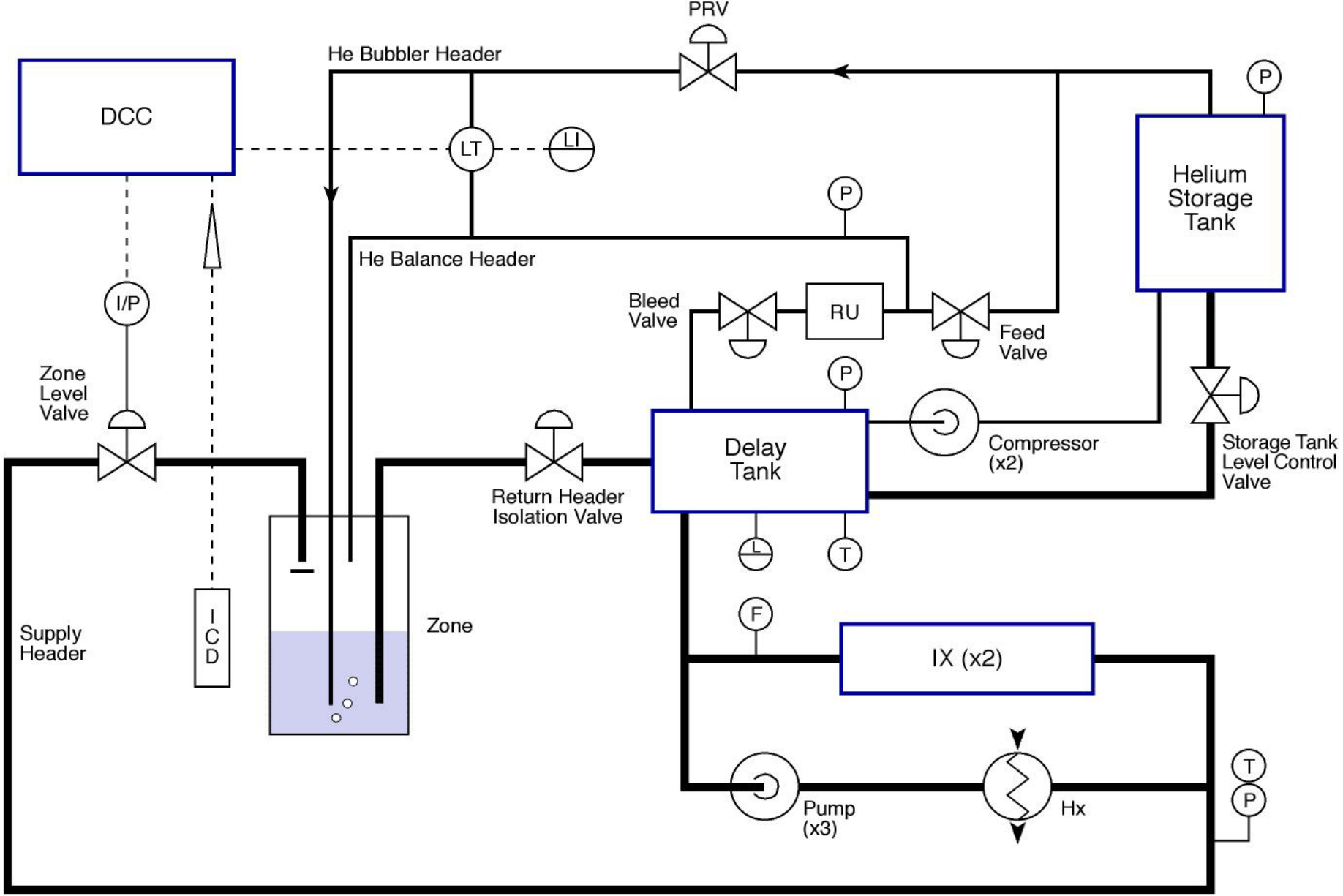


Demin Water Loop



He Loop


Bubble Header
HX2
Balance Header
Feed Valve
Bleed Valve
Helium Storage Tank
Bubbler Tube
Storage Tank LCV
Zone Control Unit
Delay Tank
Storage Tank LCV
Helium Compressor



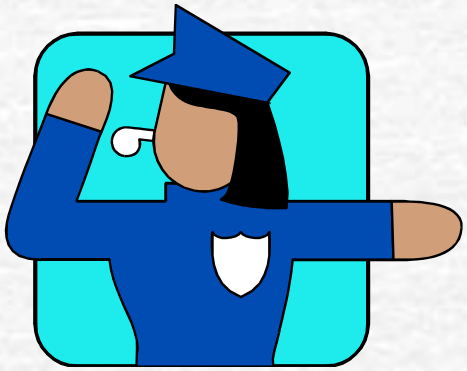
Liquid Zone Process

Reactivity Devices

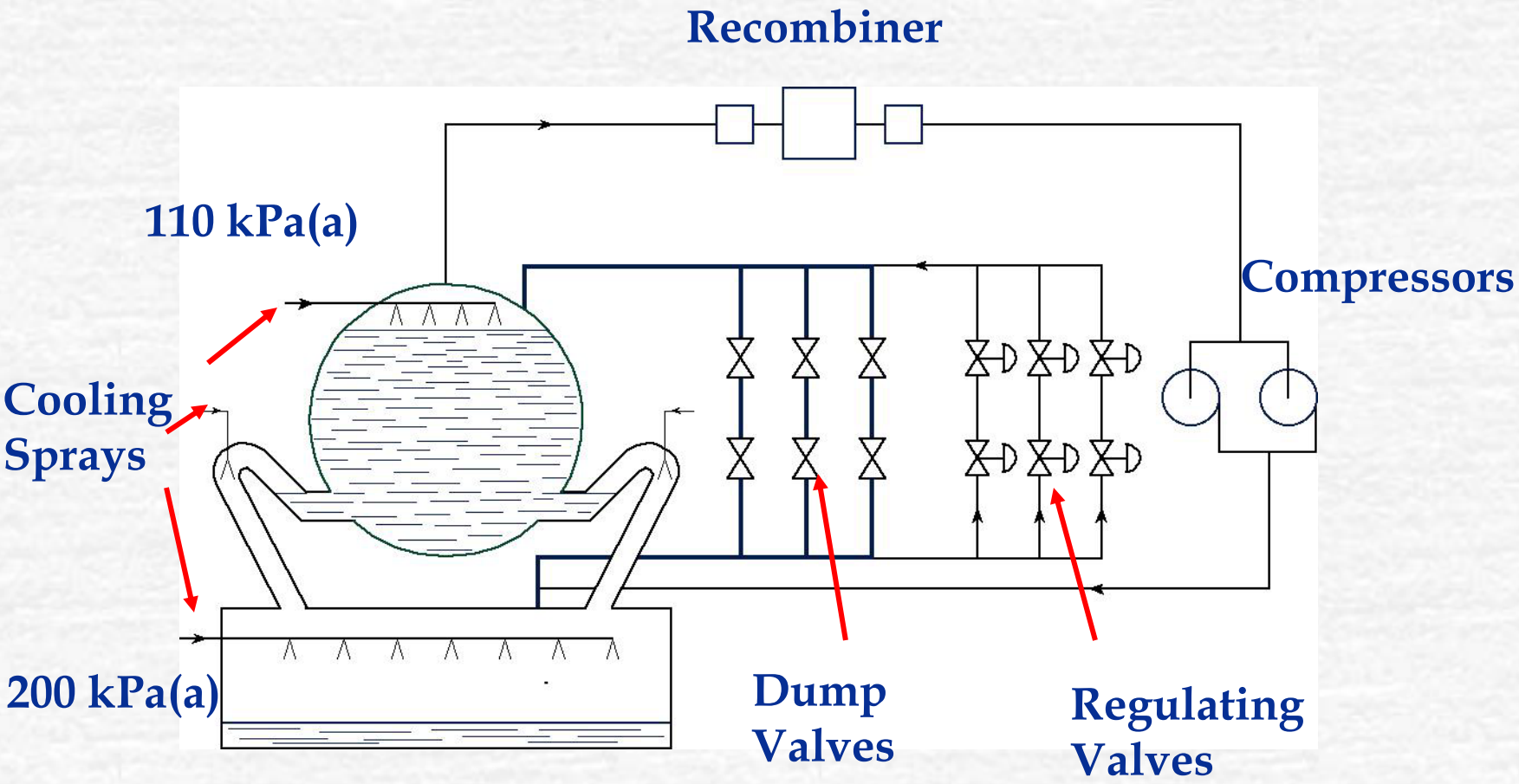
- Zones
  - must be in service to run at full power
  - fine control
- Manual Poison Addition
  - boron or gadolinium added to moderator
- Control Absorbers
  - 4 cadmium rods
  - normally out of core
  - can drive or drop into core

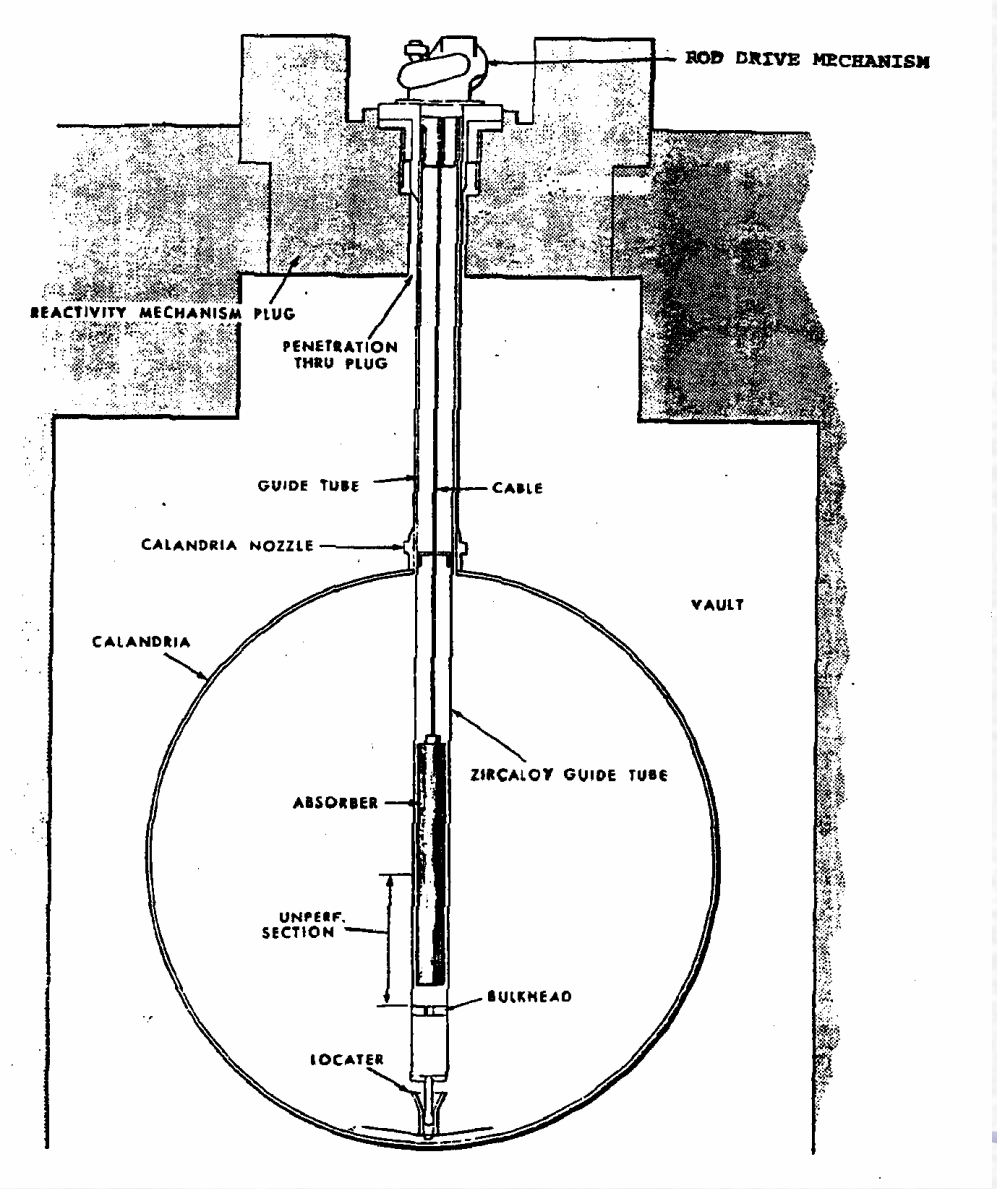
More Reactivity Devices

- Adjuster Rods
  - stainless steel or cobalt
  - normally in-core
  - poison override
  - flux flattening
- Shutdown Systems
  - shutoff rods
  - poison injection
- On-Line Fuelling
  - coarse positive reactivity addition

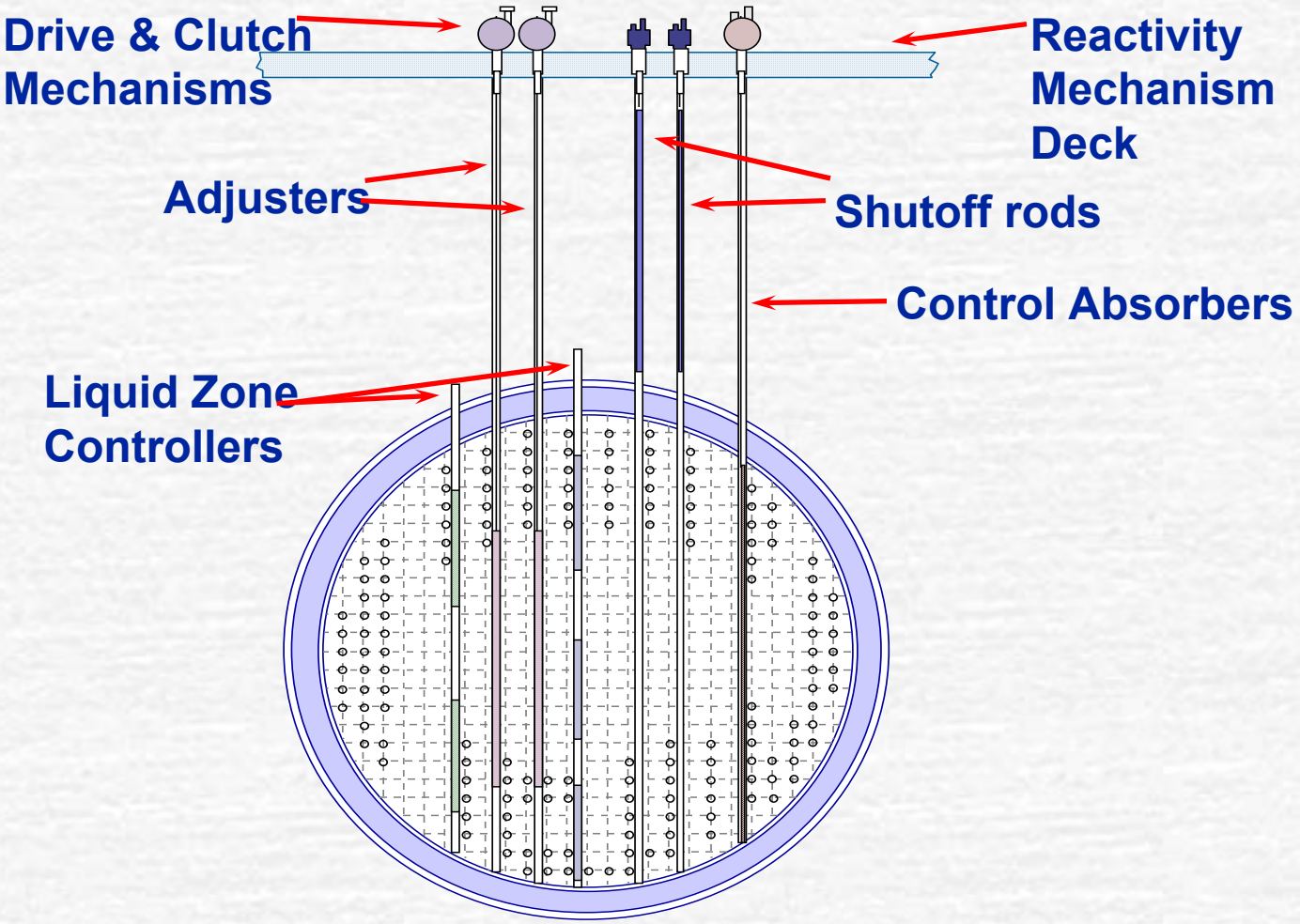


Moderator Level Control and Moderator Dump




ROD DRIVE MECHANISM
REACTIVITY MECHANISM PLUG
PENETRATION THRU PLUG
GUIDE TUBE
CABLE
CALANDRIA NOZZLE
VAULT
CALANDRIA
ZIRCALOY GUIDE TUBE
ABSORBER
UNPERF. SECTION
BULKHEAD
LOCATER

Typical Reactivity Mechanism Setup

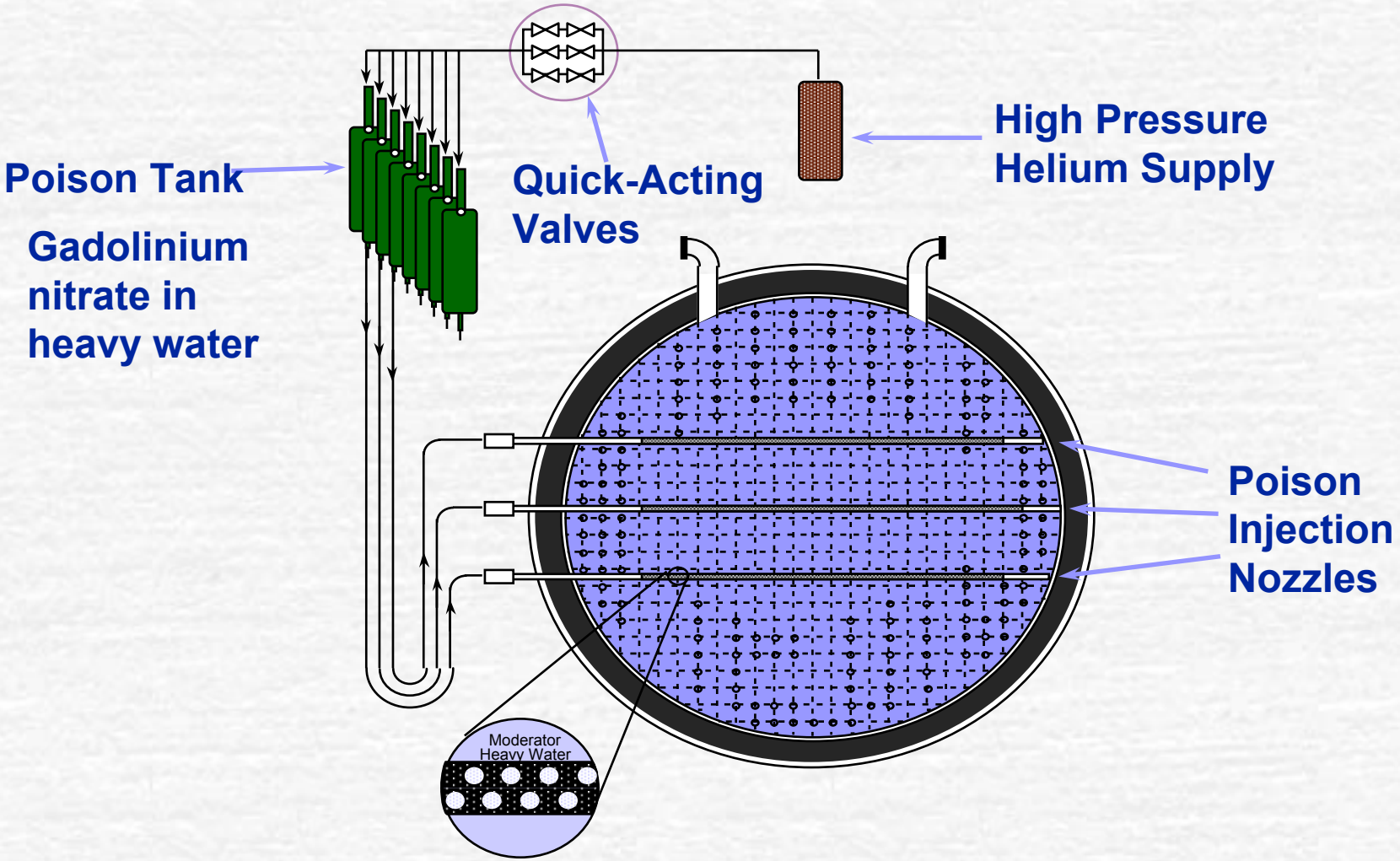


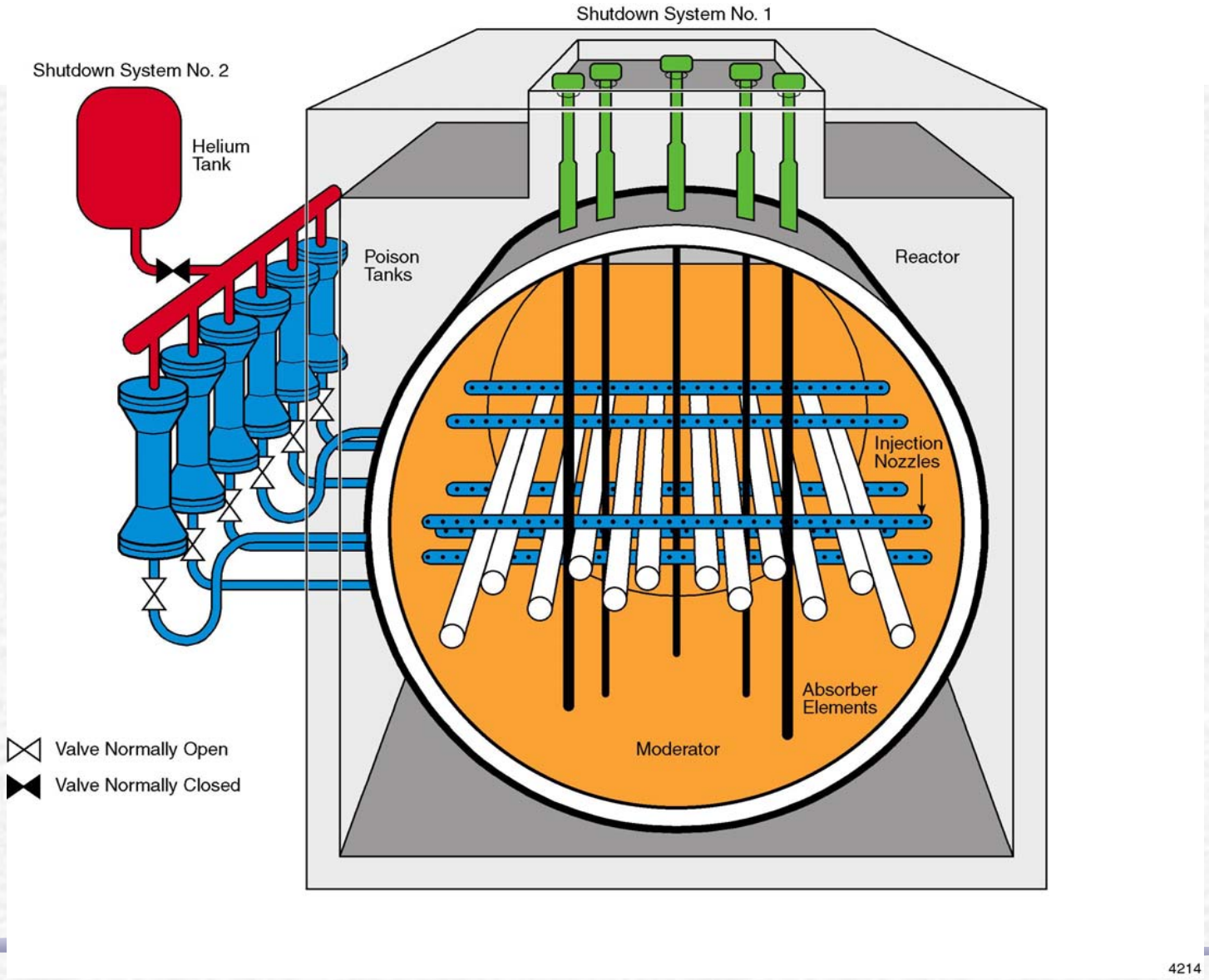
Reactor Protection

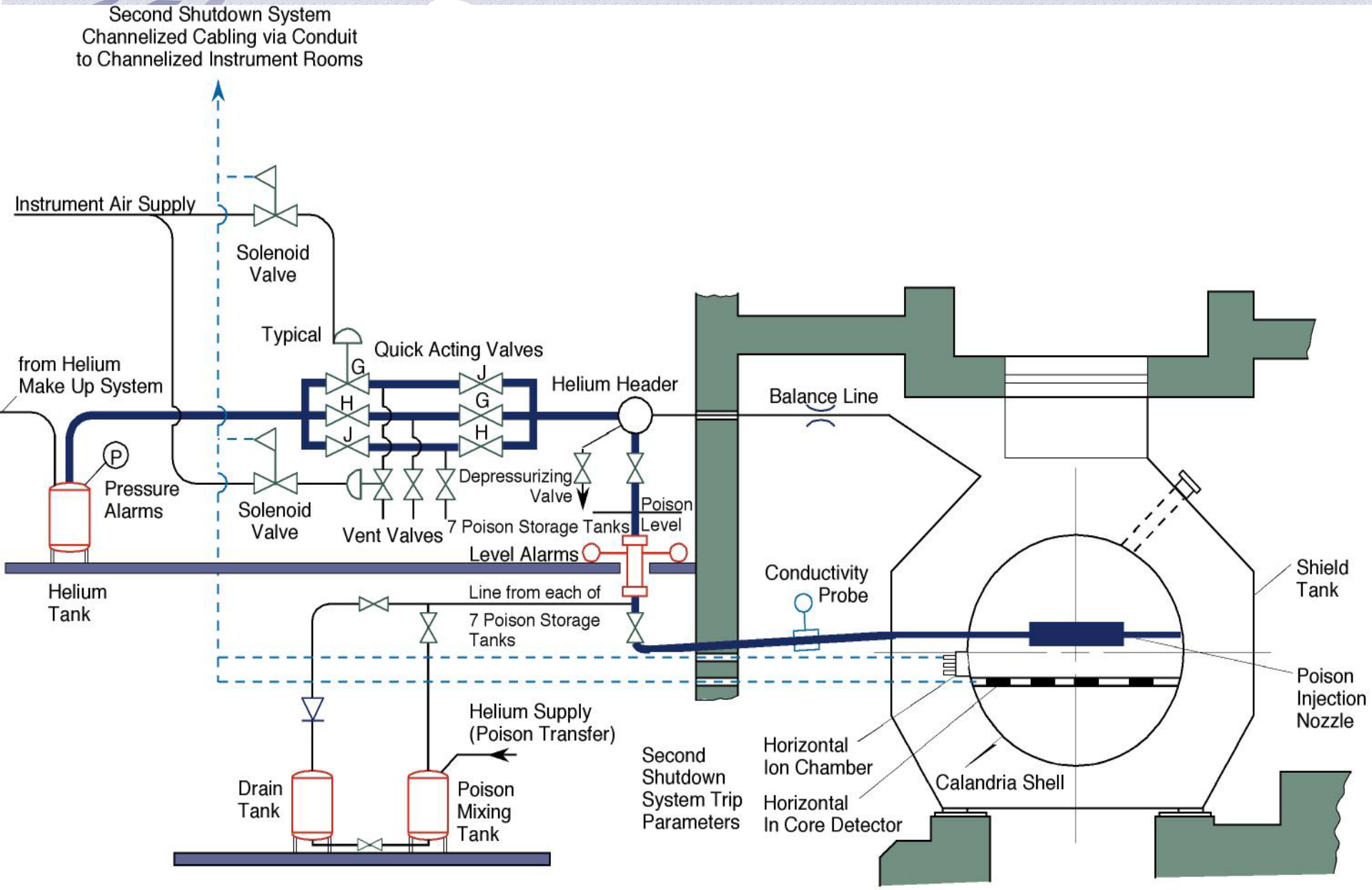
SDS#1

- ≈ 30 rods
- Poised above core
- Held by electrical clutches
- De-energizing clutches drop rods
  - —Driven out by motor
- Operates when parameters that indicate control cool or contain is being jeopardize
  - —High heat transport temperature
  - —Low boiler level
  - —High rate of power changes

General Schematic of Shutdown System 2 (Liquid Poison Injection)

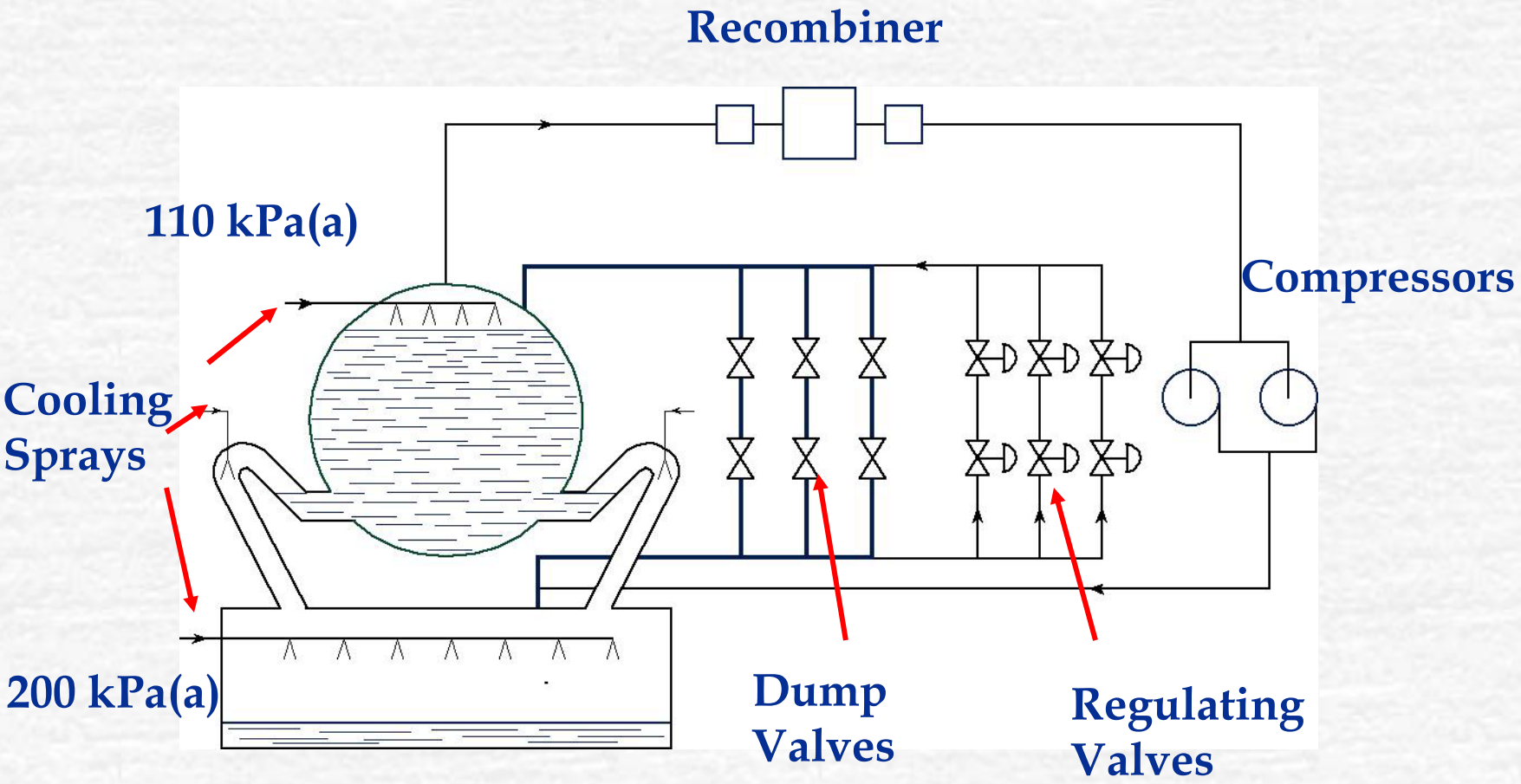



Shutdown System No. 1
Shutdown System No. 2
Helium Tank
Poison Tanks
Reactor
Injection Nozzles
Absorber Elements
Moderator
Valve Normally Open
Valve Normally Closed
4214

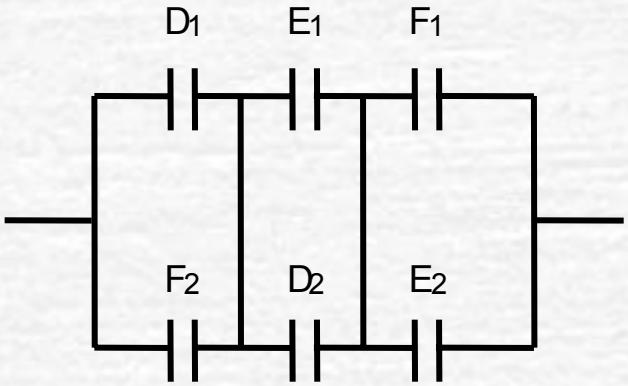


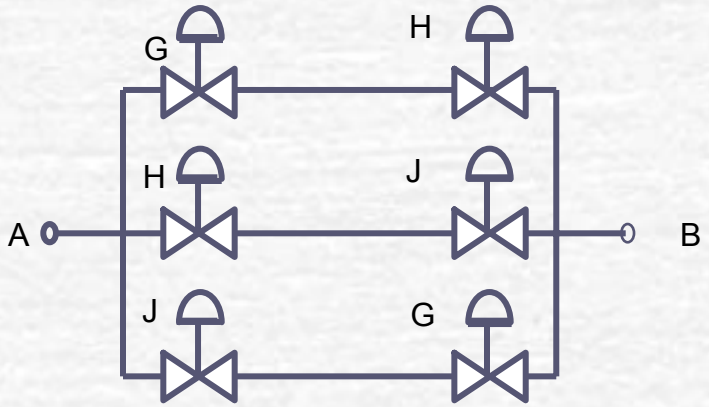
Second Shutdown System Simplified Schematic

Moderator Level Control and Moderator Dump



Triplicated logic





All Valves Air to Close

Quick Opening