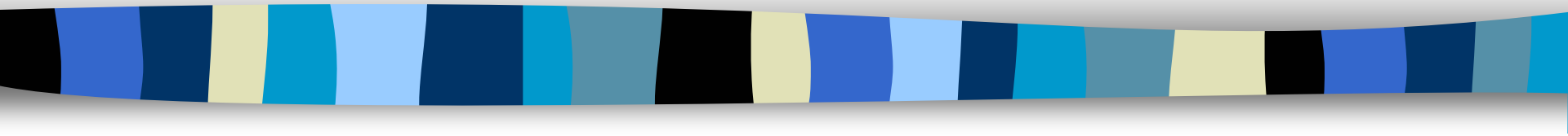
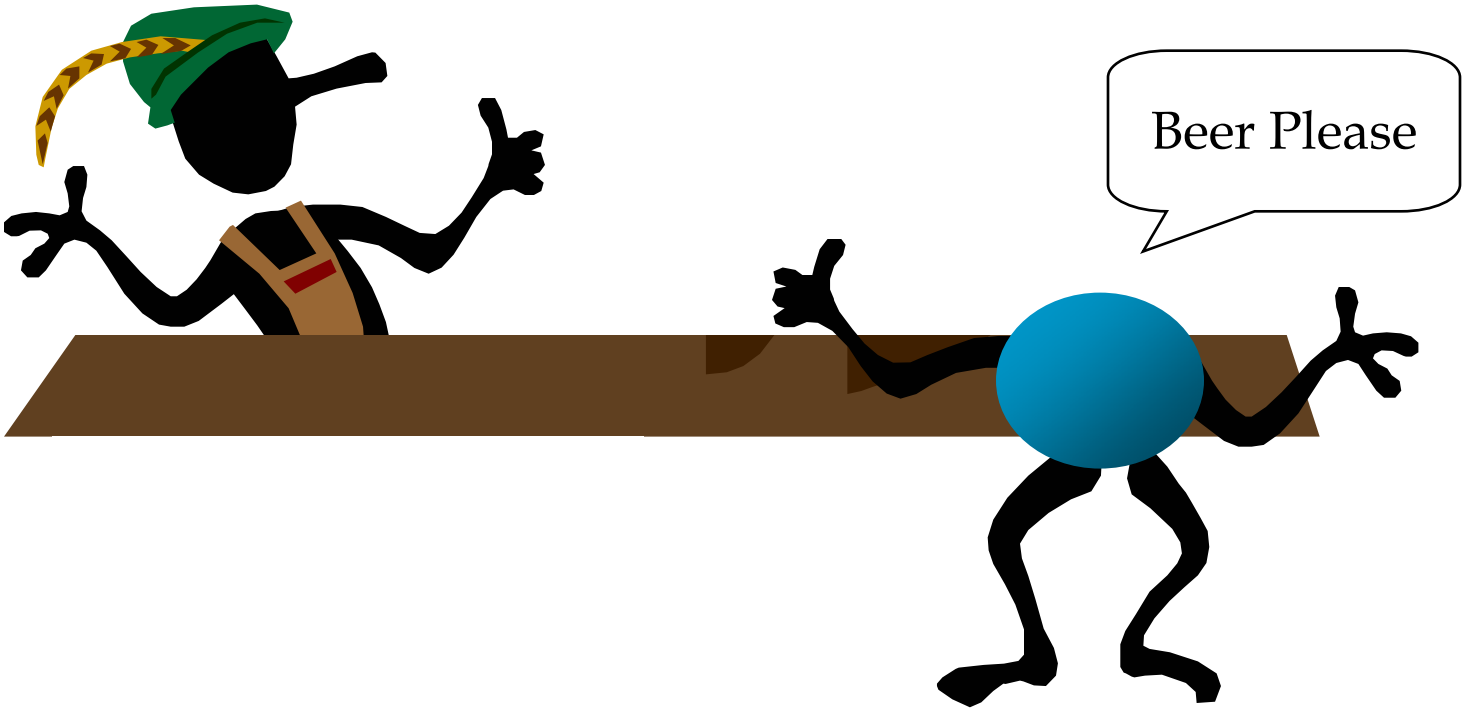
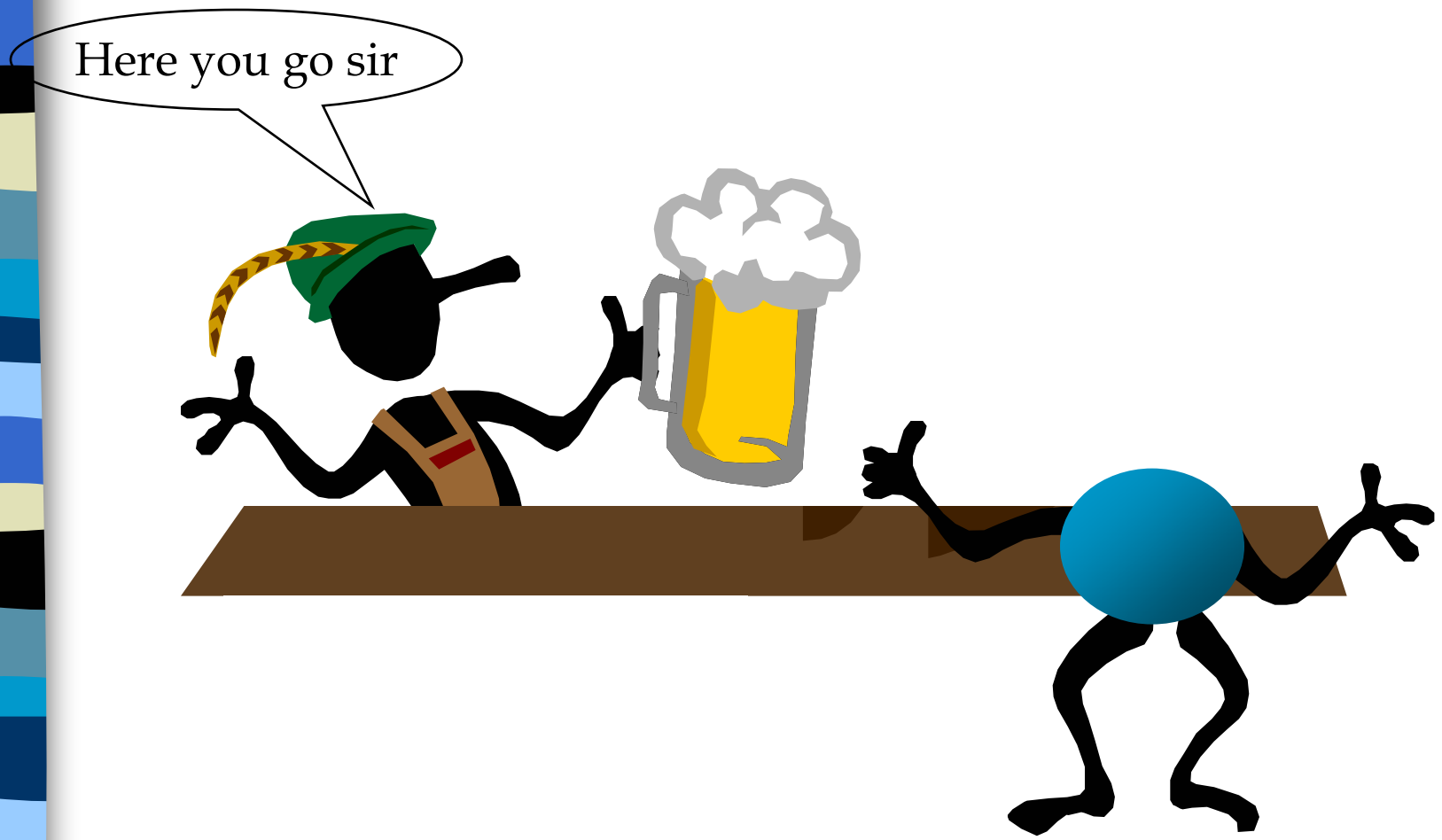
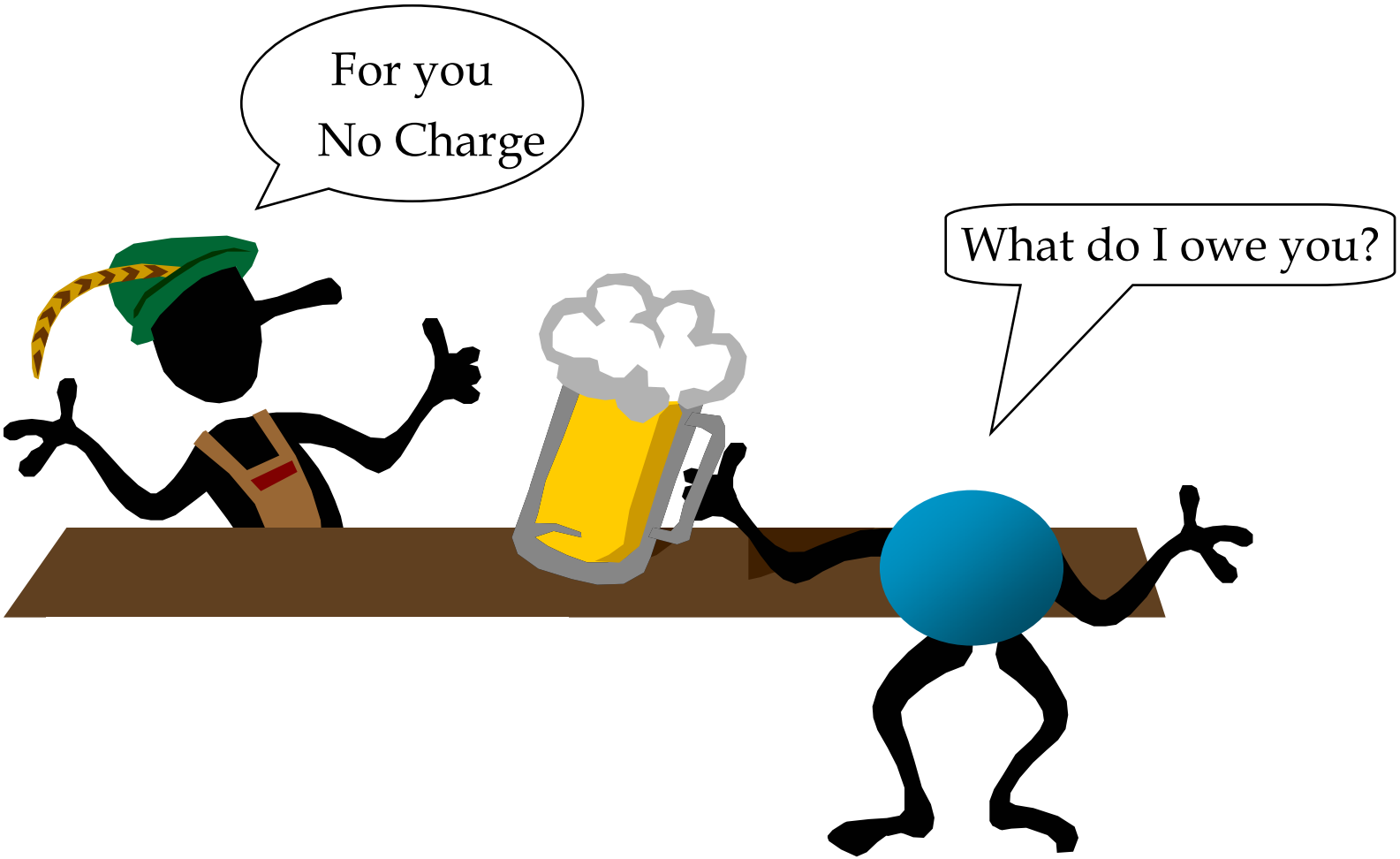
Moderator System



A neutron walks into a bar




Here you go sir


For you
No Charge
What do I owe you?

D_2O Isotopic

- **Percentage of D_2O by weight**

$$\text{Isotopic} = \frac{\text{Mass of } D_2O}{\text{Mass of } D_20 + \text{mass of } H_2O} \times 100\%$$

Moderator water ≈ 99.8%

Typically 99.93%

New water as high as 99.99%

0.1% downgrading costs a million a year in fuel

Minimum allowable ≈ 99.5%

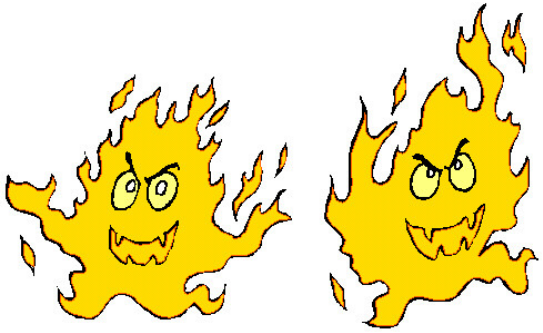
Up-graders in stations keep isotopic high

Radiation Hazards

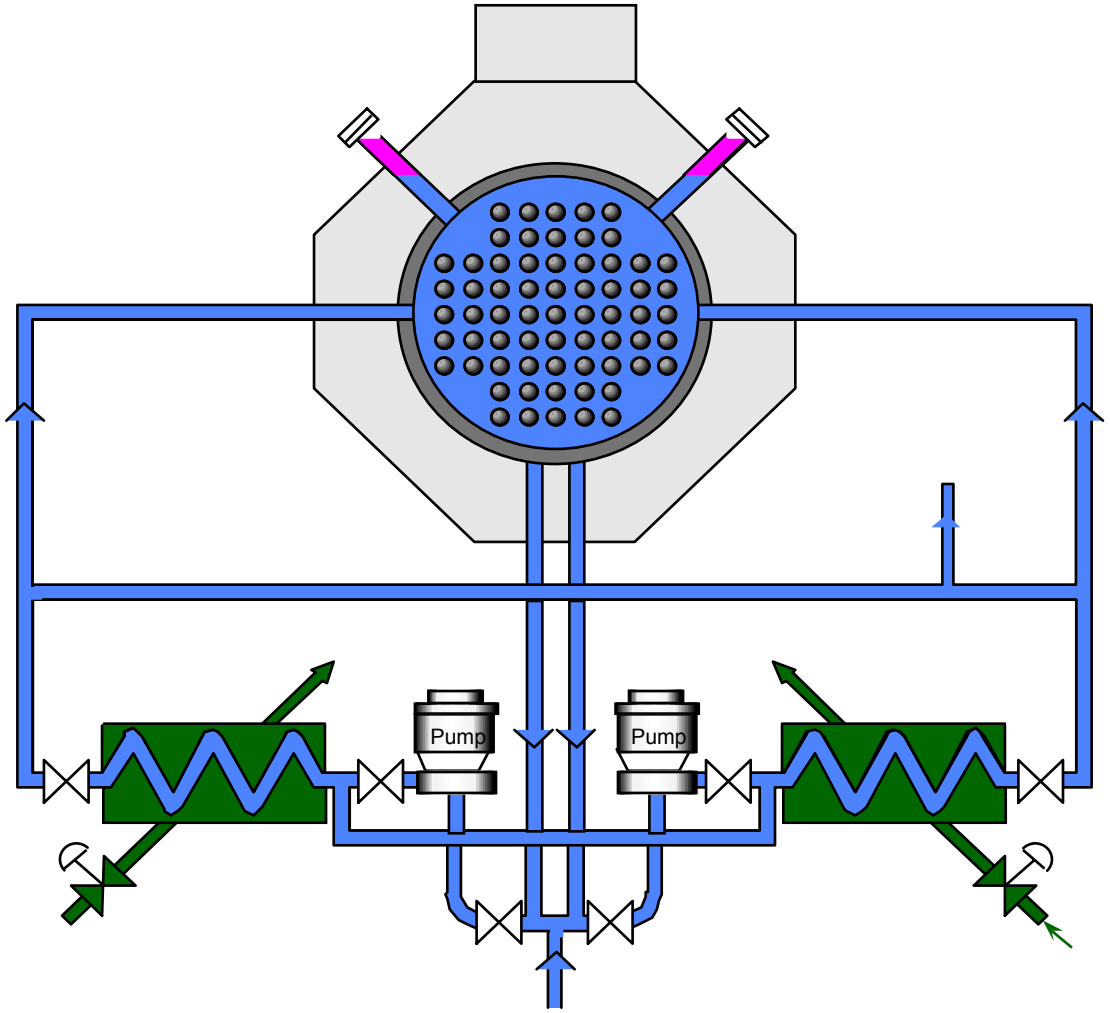
- Tritium
  - activation product from deuterium
  - low energy beta emitter
  - internal hazard only
  - detected by routine bioassay
- N-16 & O-19
  - high energy gamma and beta
  - gamma hazard when reactor is in operation
- Photoneutrons
  - anywhere there is heavy water that just circulated through the reactor

Main Moderator System

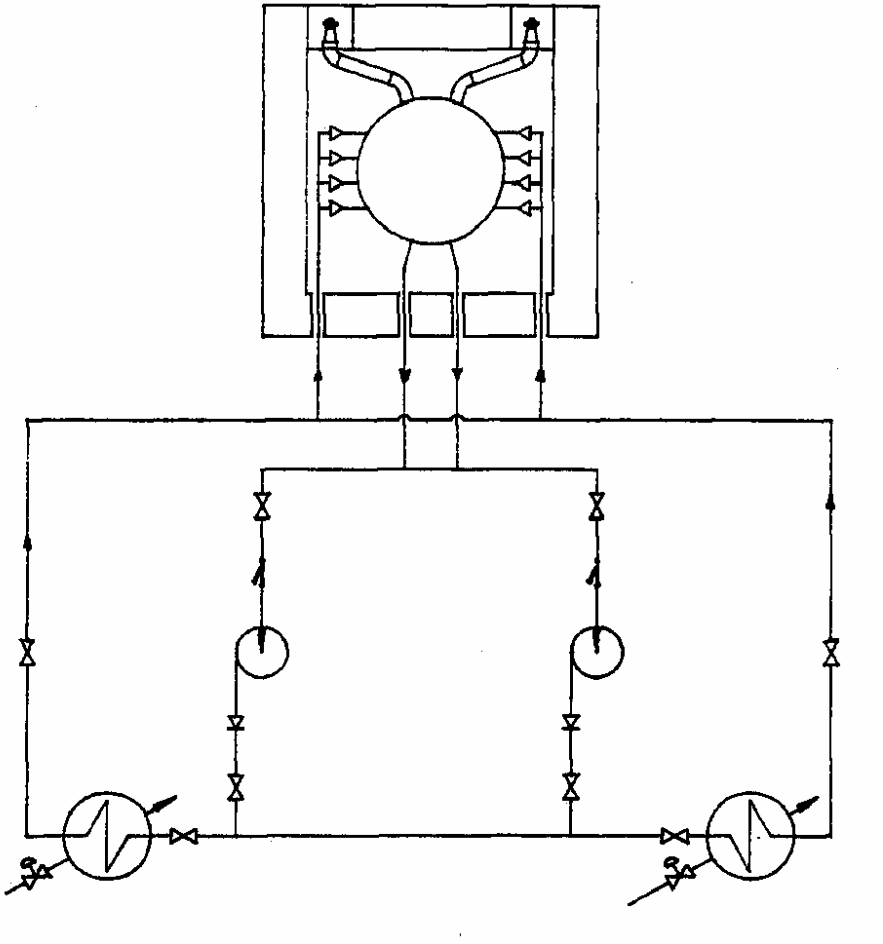
- Constant moderator temperature
  - 60°C - 70 °C
- Moderator Heat Sources
  - prompt radiation from fission (neutrons & gamma)
  - fission product decay (gamma)
  - conventional heating



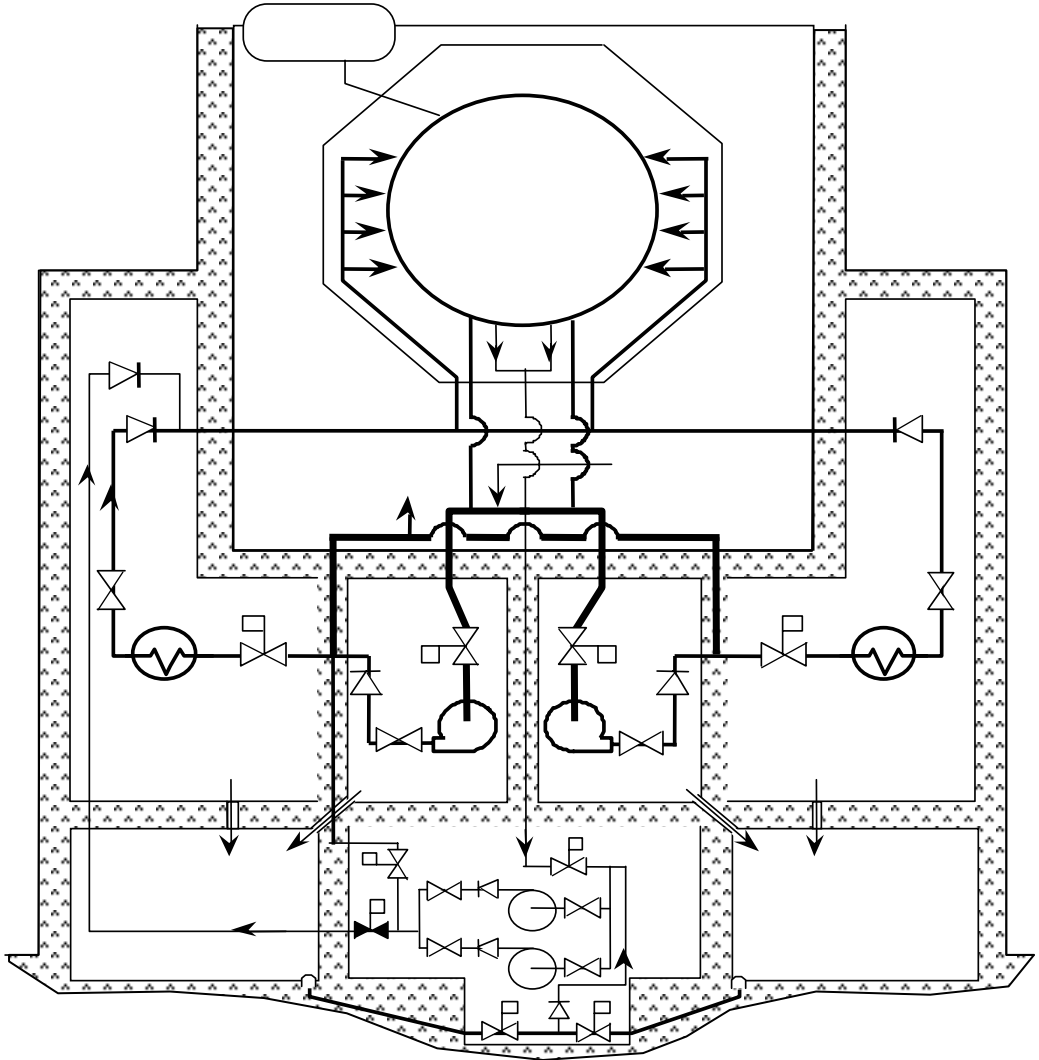
Simplified Main Moderator System



Main Moderator System



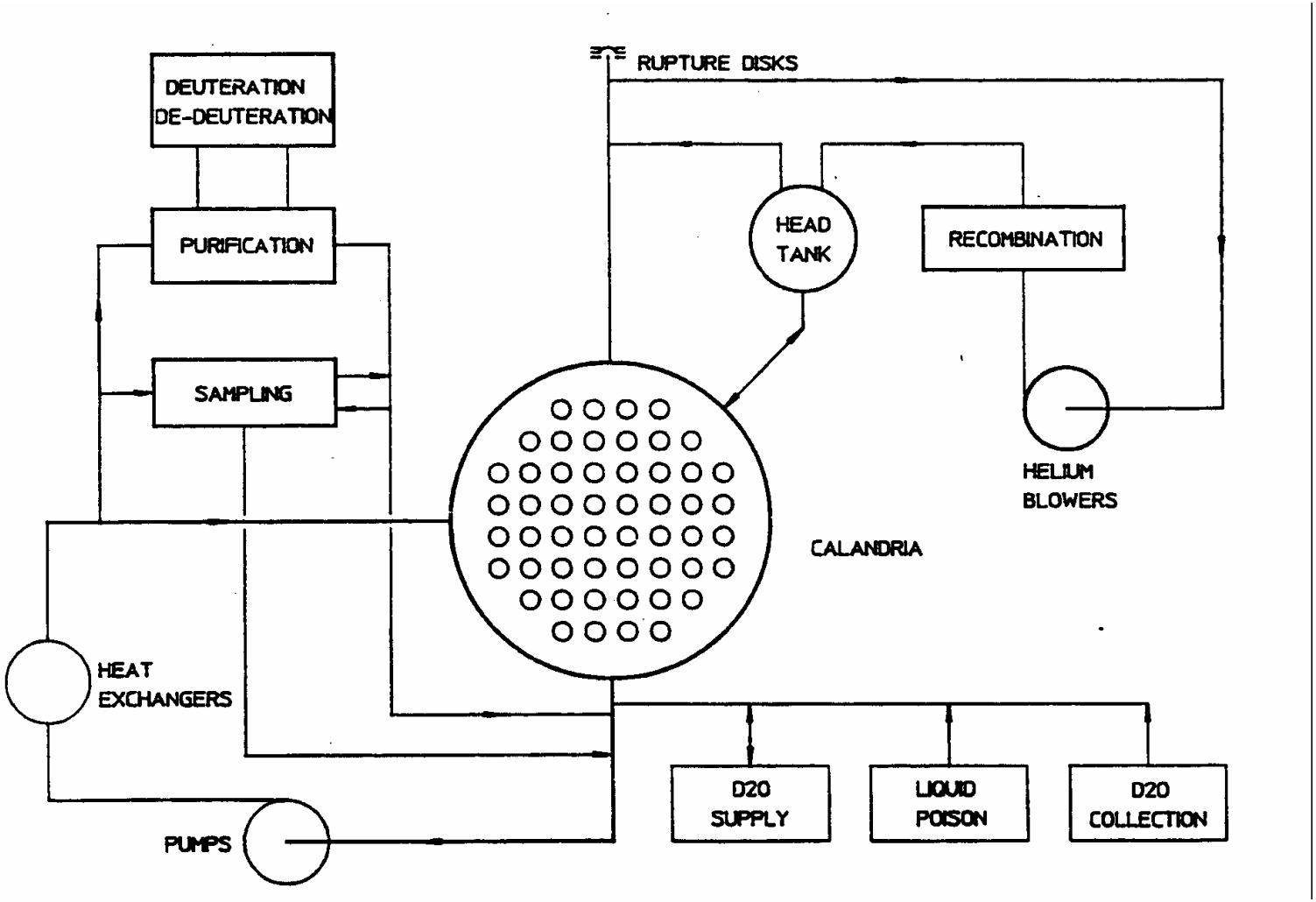
Moderator System Layout

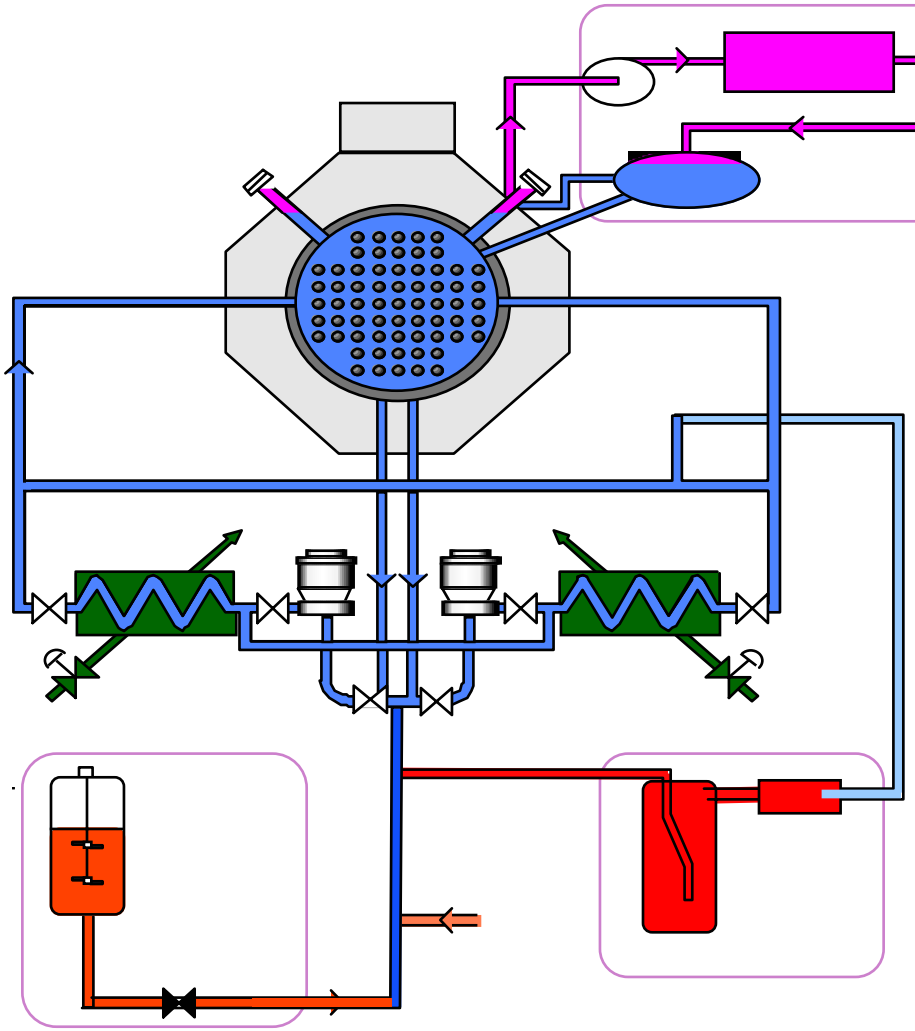


Moderator Auxiliaries

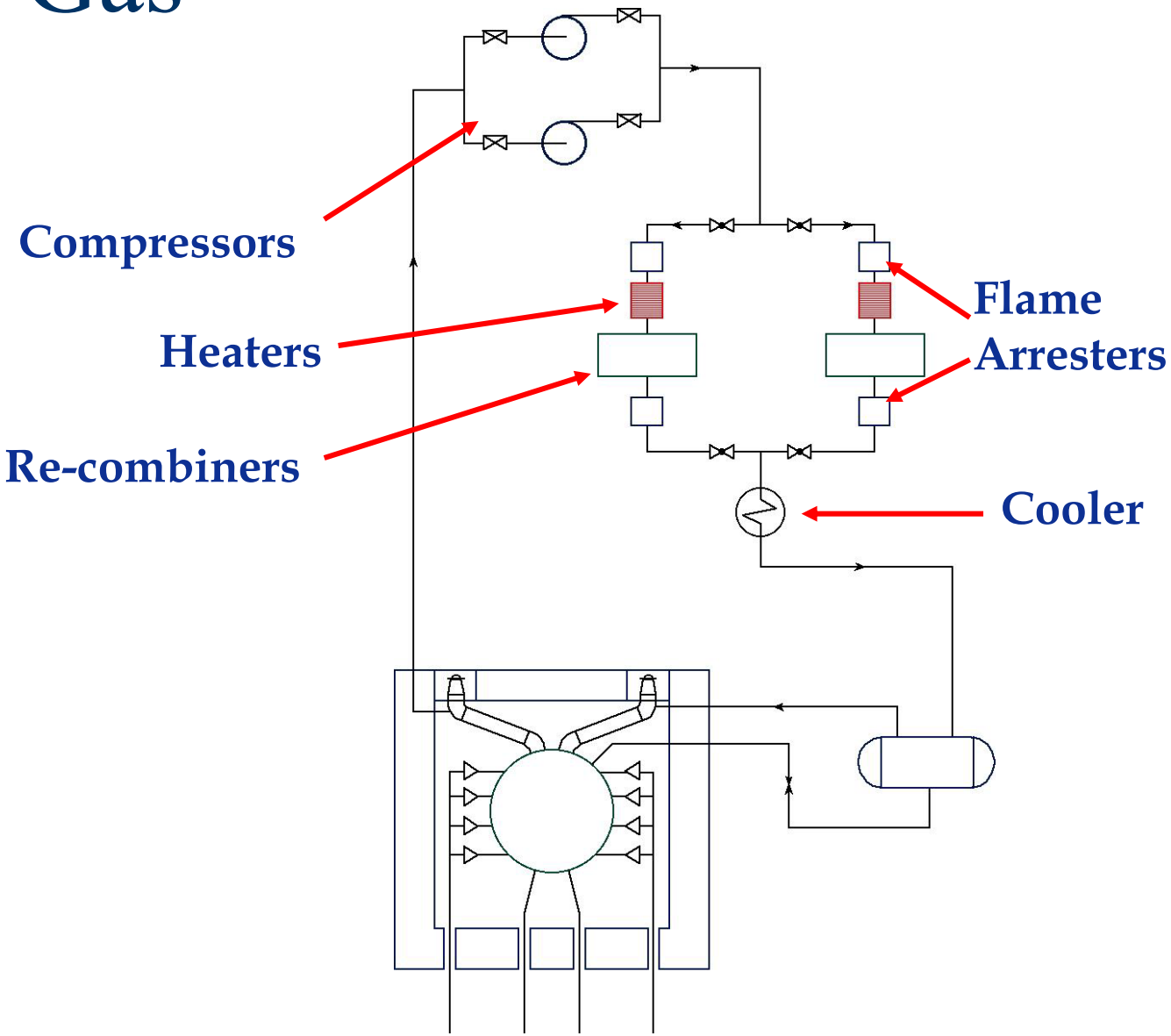
13 February, 2004

Auxiliary Systems

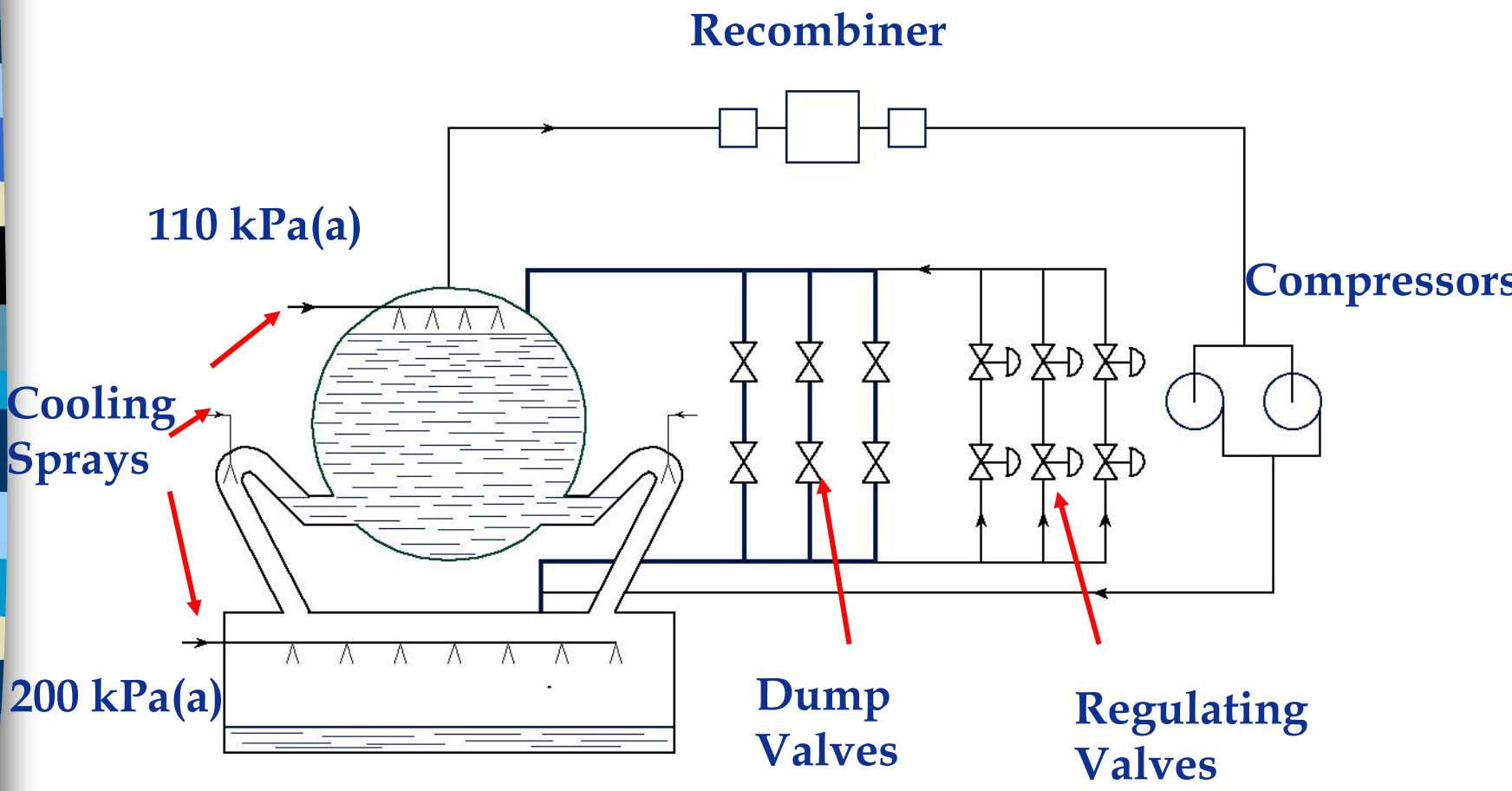



Cover Gas
Poison Addition
Purification
Collection & Make-up

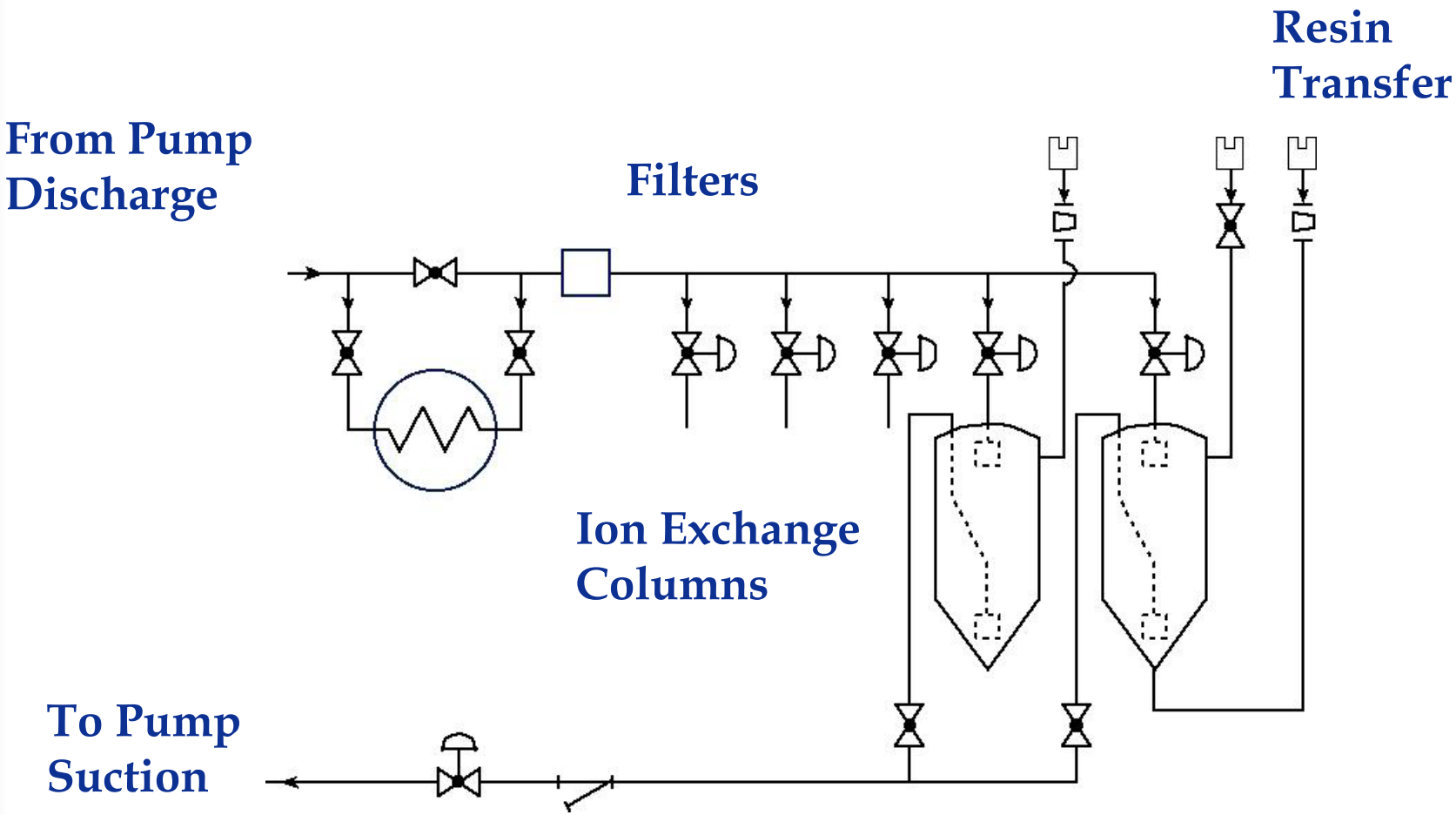
Cover Gas



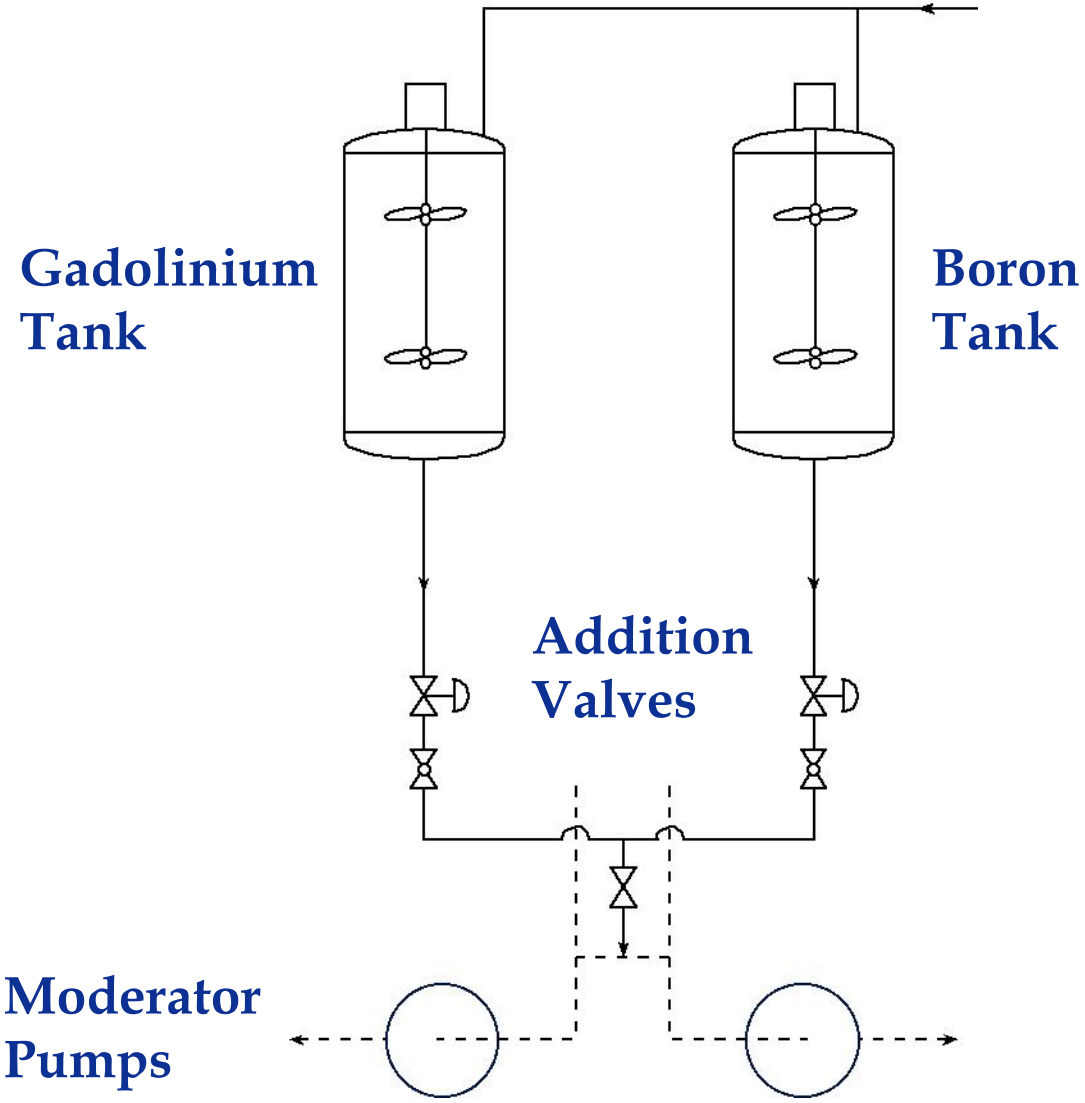
Dump Tank and Level Control



Purification



Liquid Poison Addition



Liquid Poison Addition

More Moderator Stuff

- D_20 collection
- Auxiliary Cooling
  - reactivity mechanisms
- Deuteration and De-Deuteration