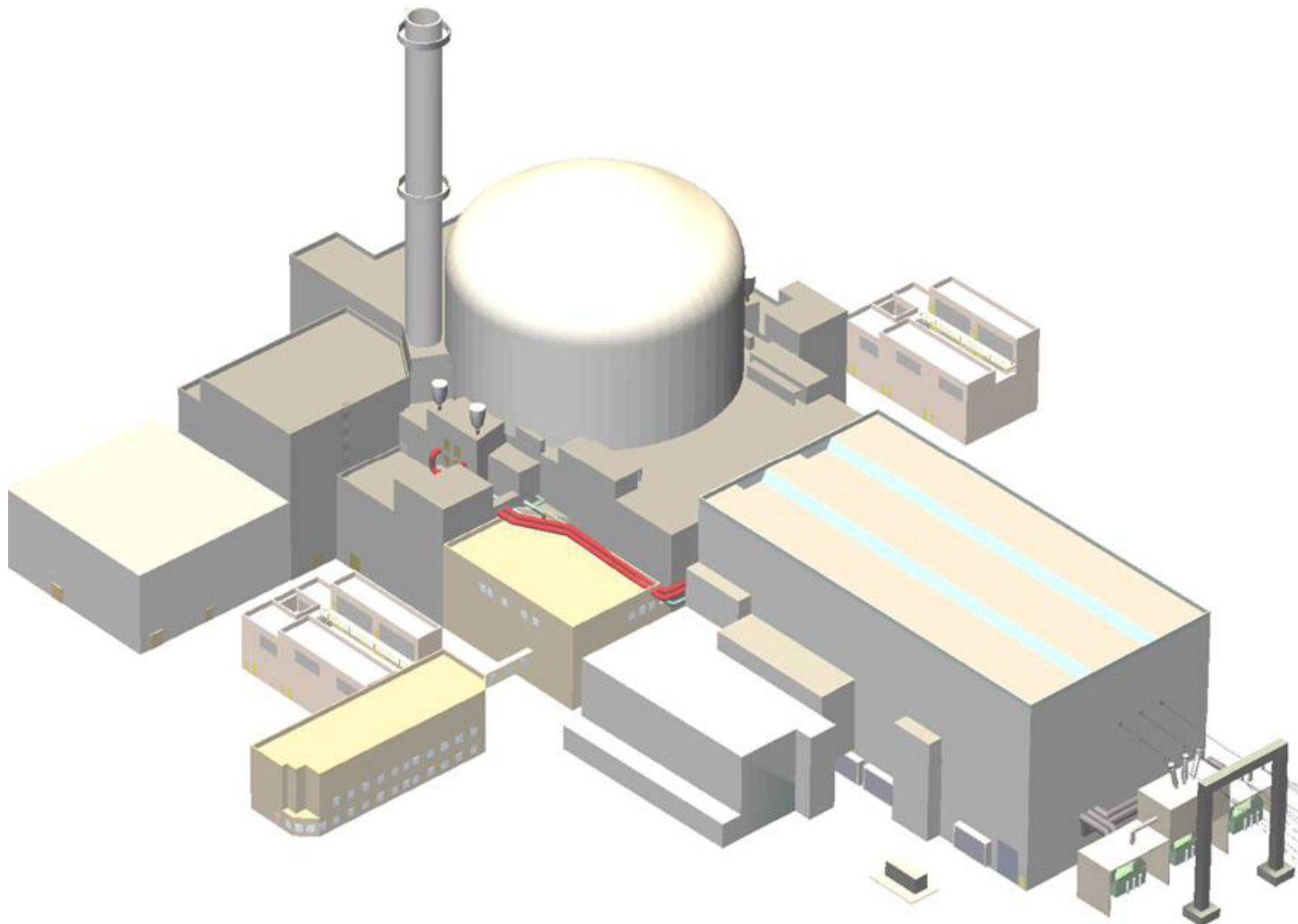


5.0 Safety-Related Systems



Objectives

- 1. State the purposes, and describe the operation of, the following safety-related systems:**
 - a. Safety injection system/residual heat removal system,**
 - b. Component cooling water system,**
 - c. Essential service water system,**
 - d. Emergency feedwater system,**
 - e. Extra borating system, and**
 - f. Fuel pool cooling and purification system.**
- 2. Explain the N+2 4-train safety concept.**
- 3. List the systems that are arranged in 4-train and 2-train safety configurations.**
- 4. Describe the major differences between the safety-related systems of the US-EPR design and those of currently operating PWRs.**

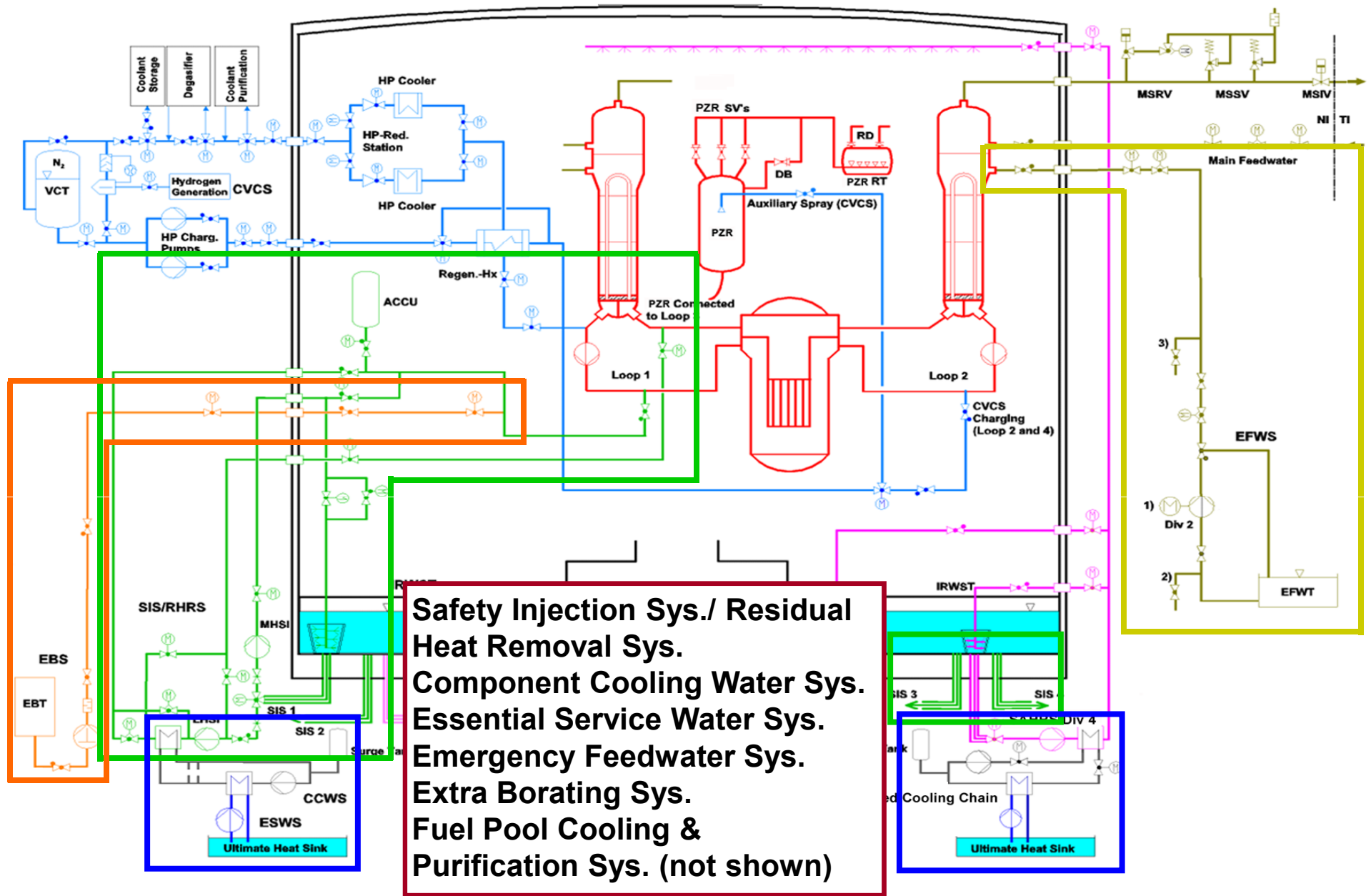


Fig. 5-1 Major Fluid Systems

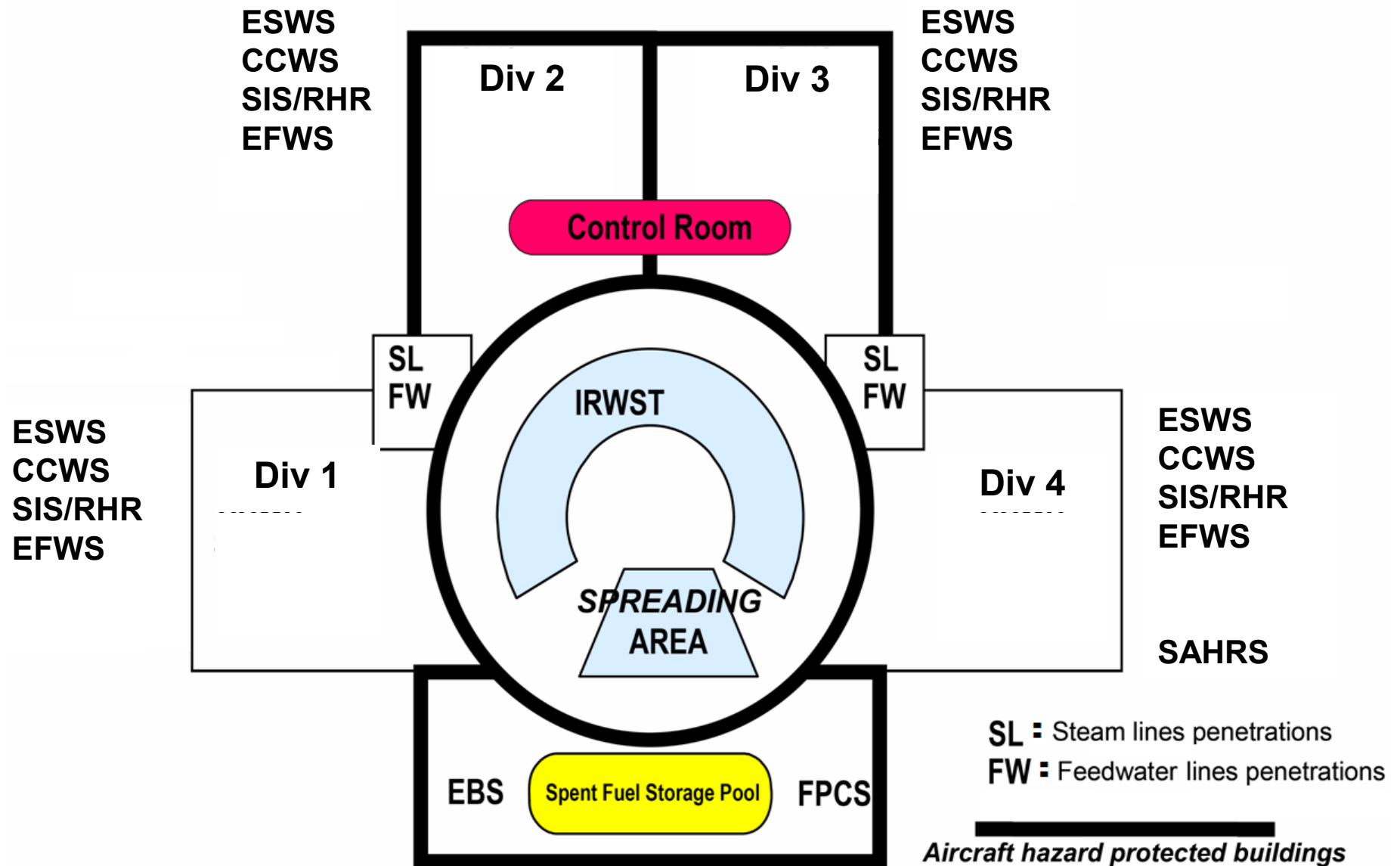
Train Redundancy

- **4-Train Systems:**
 - **SIS/RHRS**
 - **CCWS**
 - **ESWS**
 - **EFWS**
- **2-Train Systems:**
 - **EBS**
 - **FPCPS**

The Four-Train Concept



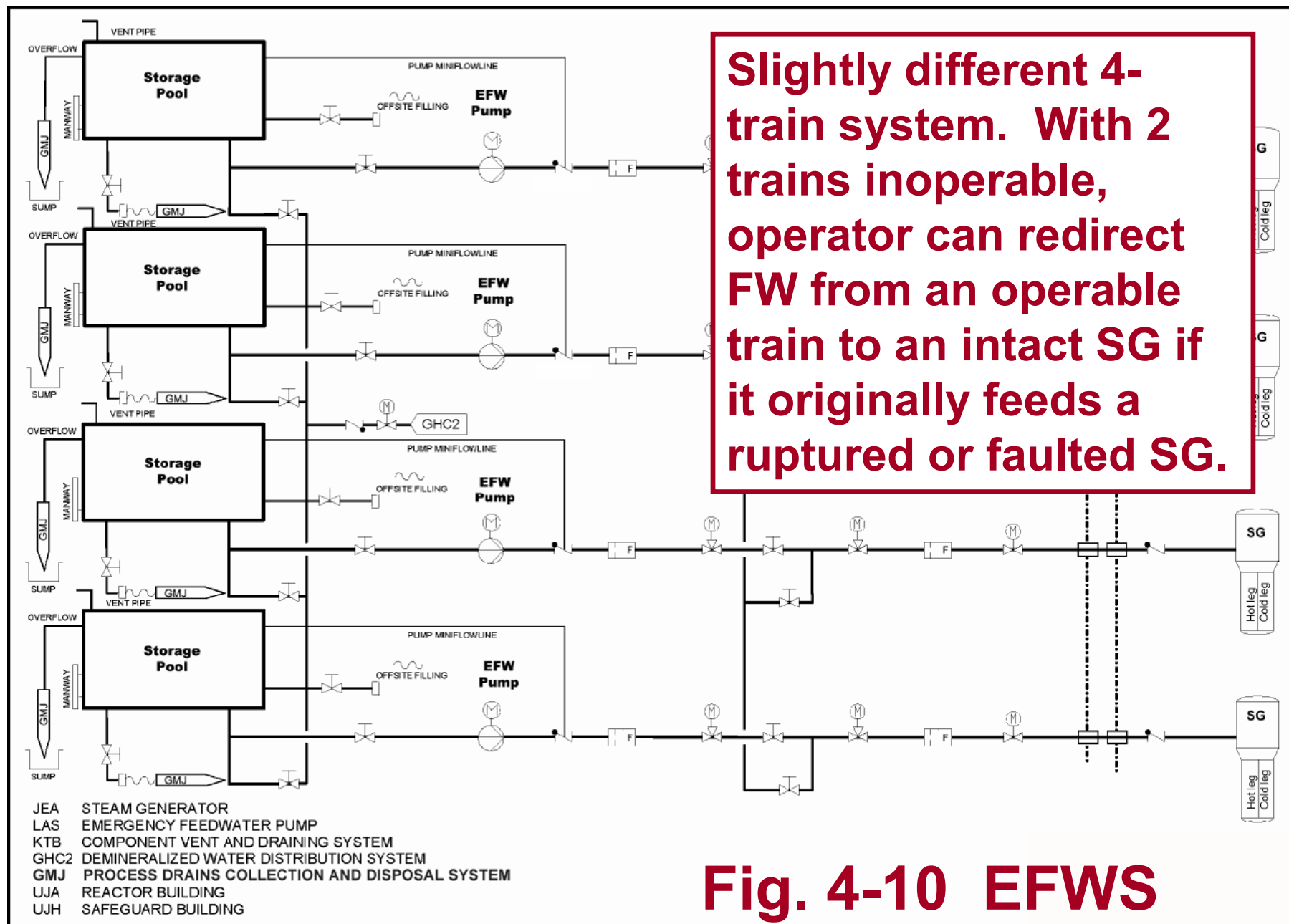
Each train of a 4-train system is independent and located within a physically separate safeguard building.



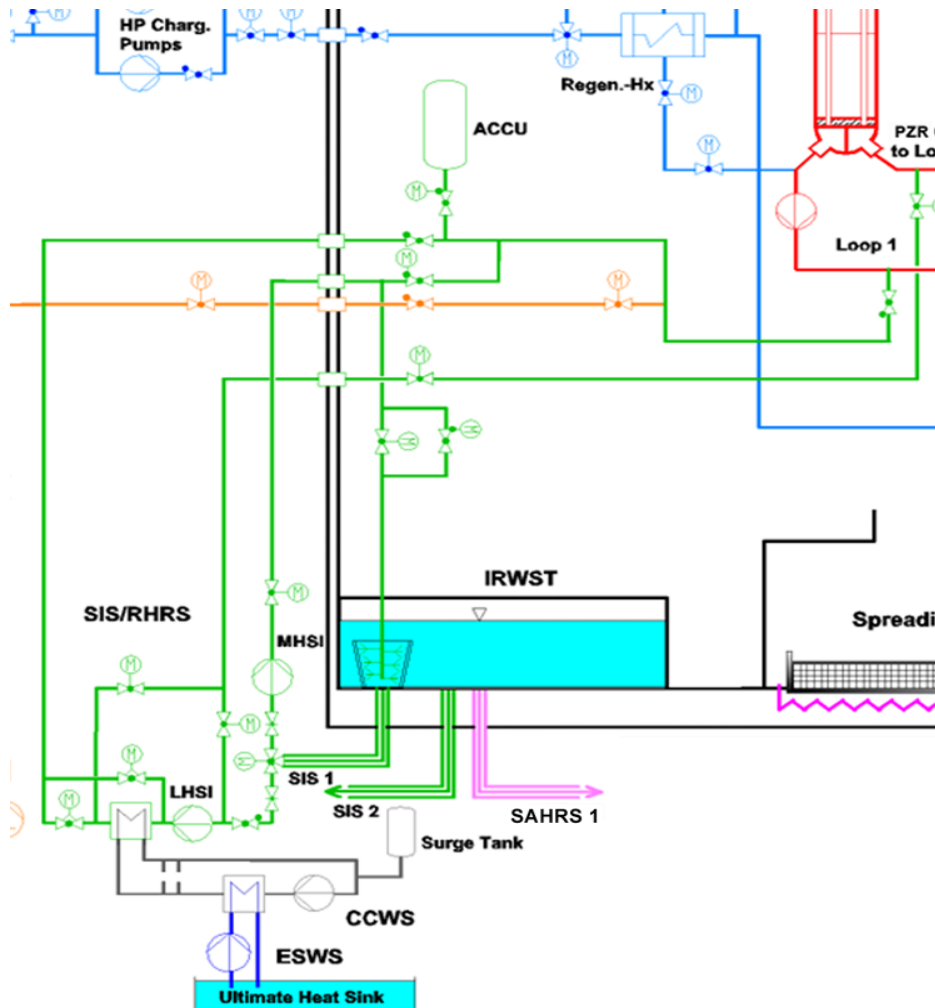
The Four-Train Concept

(N+2) Four-Train Concept

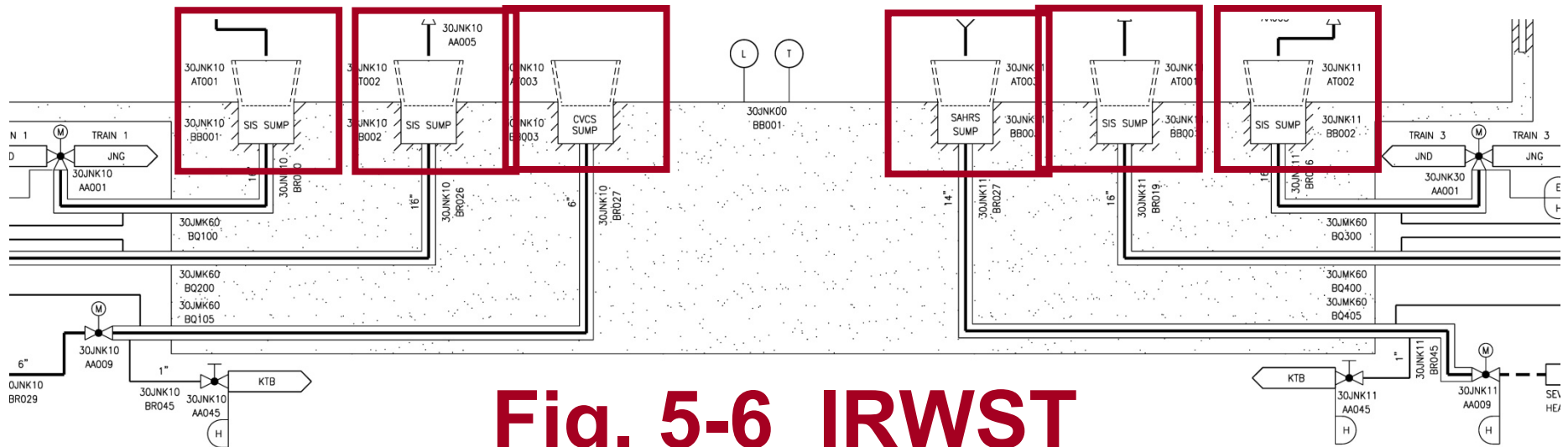
- Safety systems are comprised of 4 trains. Each is a 100%-capacity train.
 - One train may be out of service for maintenance.
 - One train may fail (single-failure criterion).
 - One train may be rendered ineffective by the nature of the accident.
 - One 100%-capacity train remains available to mitigate the accident.



Safety Injection System

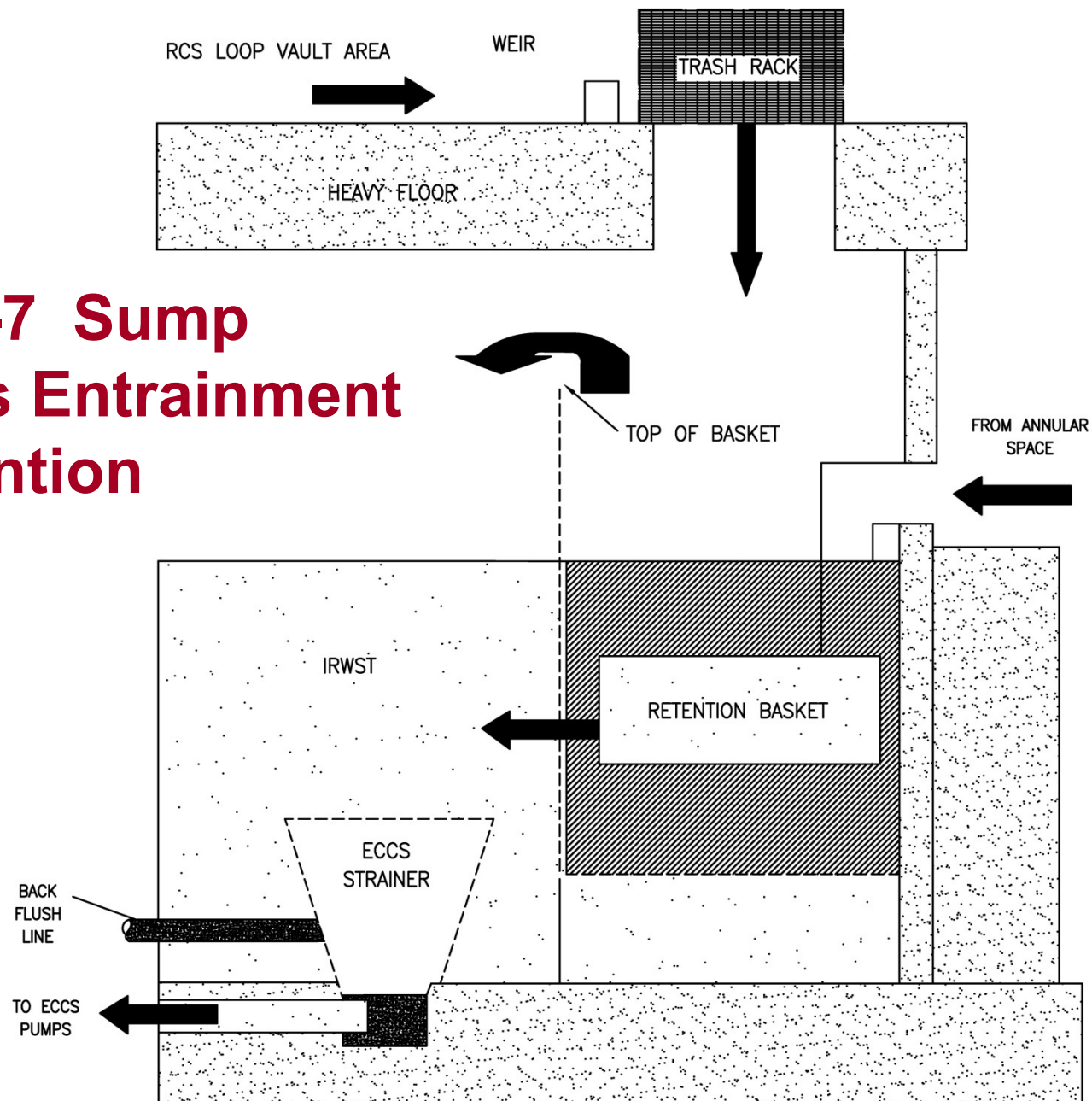


- Safety injection for accidents
- SIS + partial cooldown (MSRTs or TBVs) for SBLOCAs
- Each train:
 - MHSI (600 gpm @ 965 psig)
 - LHSI (2200 gpm @ 200 psig)
 - Accumulator (10,000 gal, 665 psig, 1800 ppm)
- Suction from IRWST
- Hot-leg injection via LHSI

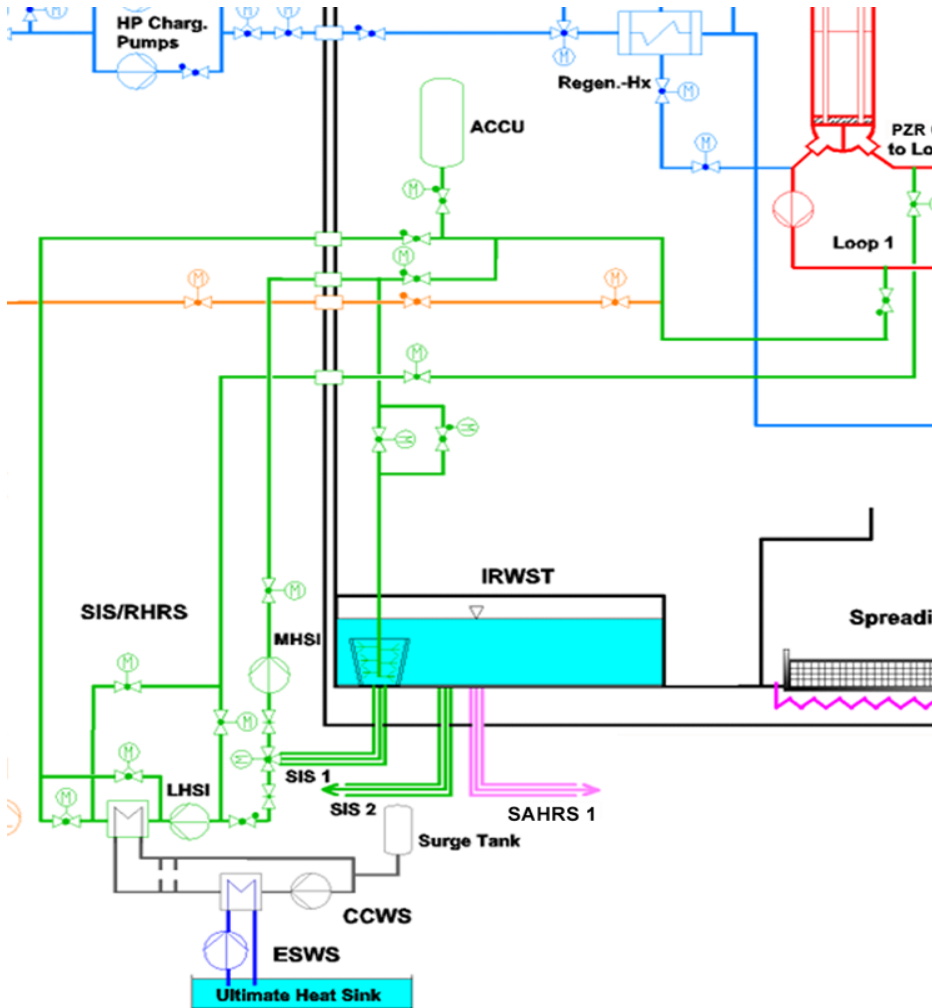


- 500,000 – 523,000 gal, 1700 - 1900 ppm
- 6 sump suctions:
 - 4 for SIS trains
 - SAHRS
 - CVCS
- Debris entrainment prevention features (next slide)
- pH adjustment baskets with Na_3PO_4 on heavy floor in return paths

**Fig. 5-7 Sump
Debris Entrainment
Prevention**



Residual Heat Removal System

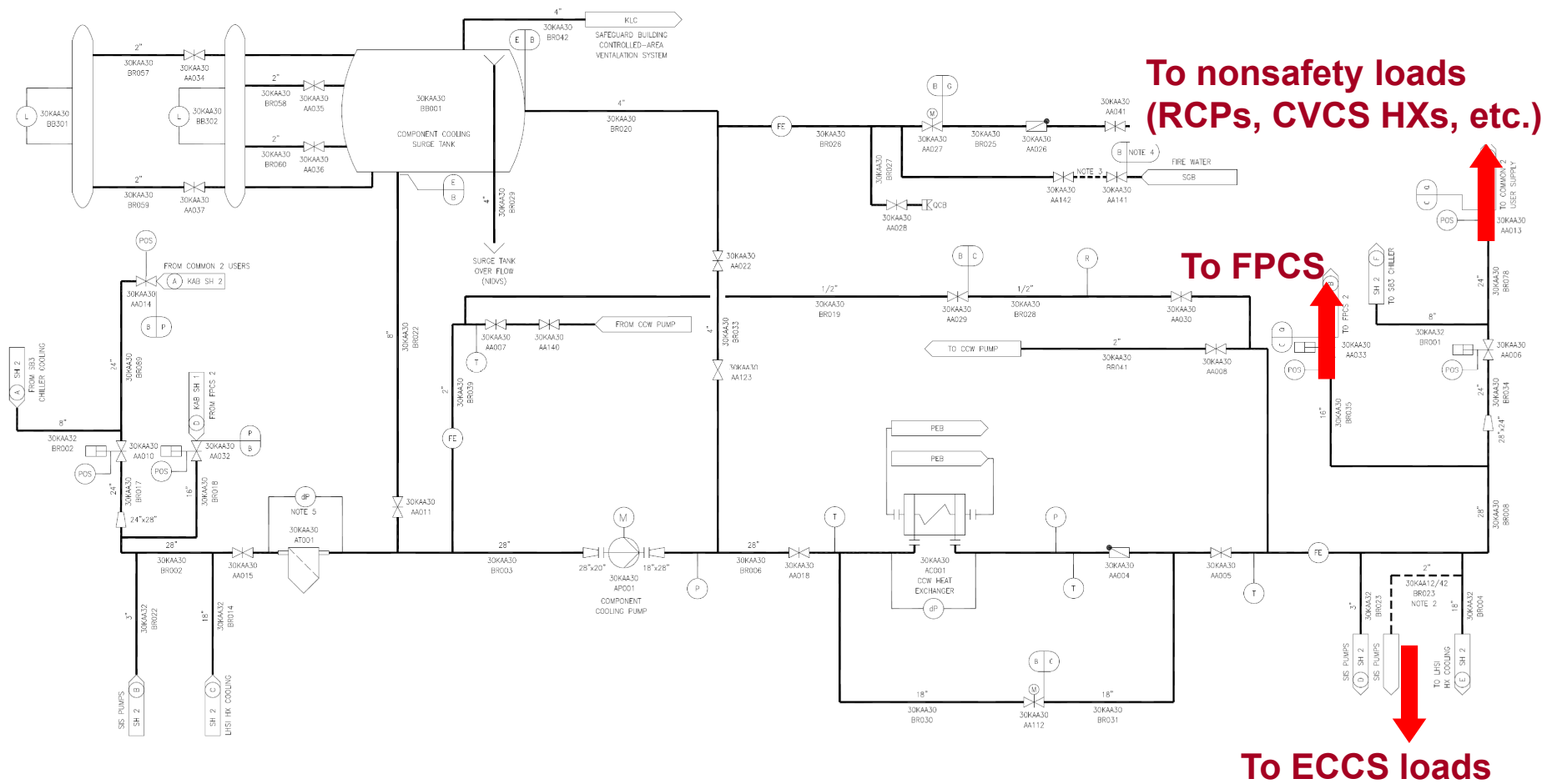


- First 2 trains in service at 390 psia, 250°F
- Remaining 2 trains in service at 212°F
- ~ 15 hr to cool down to 131°F with all 4 trains

Component Cooling Water System

- Cools safety-related and nonsafety-related loads
- Depending on loads, 2, 3, or 4 trains operating
- Trains are configured in pairs (1 & 2, 3 & 4); either train of each pair supplies 1 of 2 common load groups
- SIS actuation automatically supplies CCW flow to LHSI HXs
- Nonsafety-related 5th train dedicated to SAHRS cooling

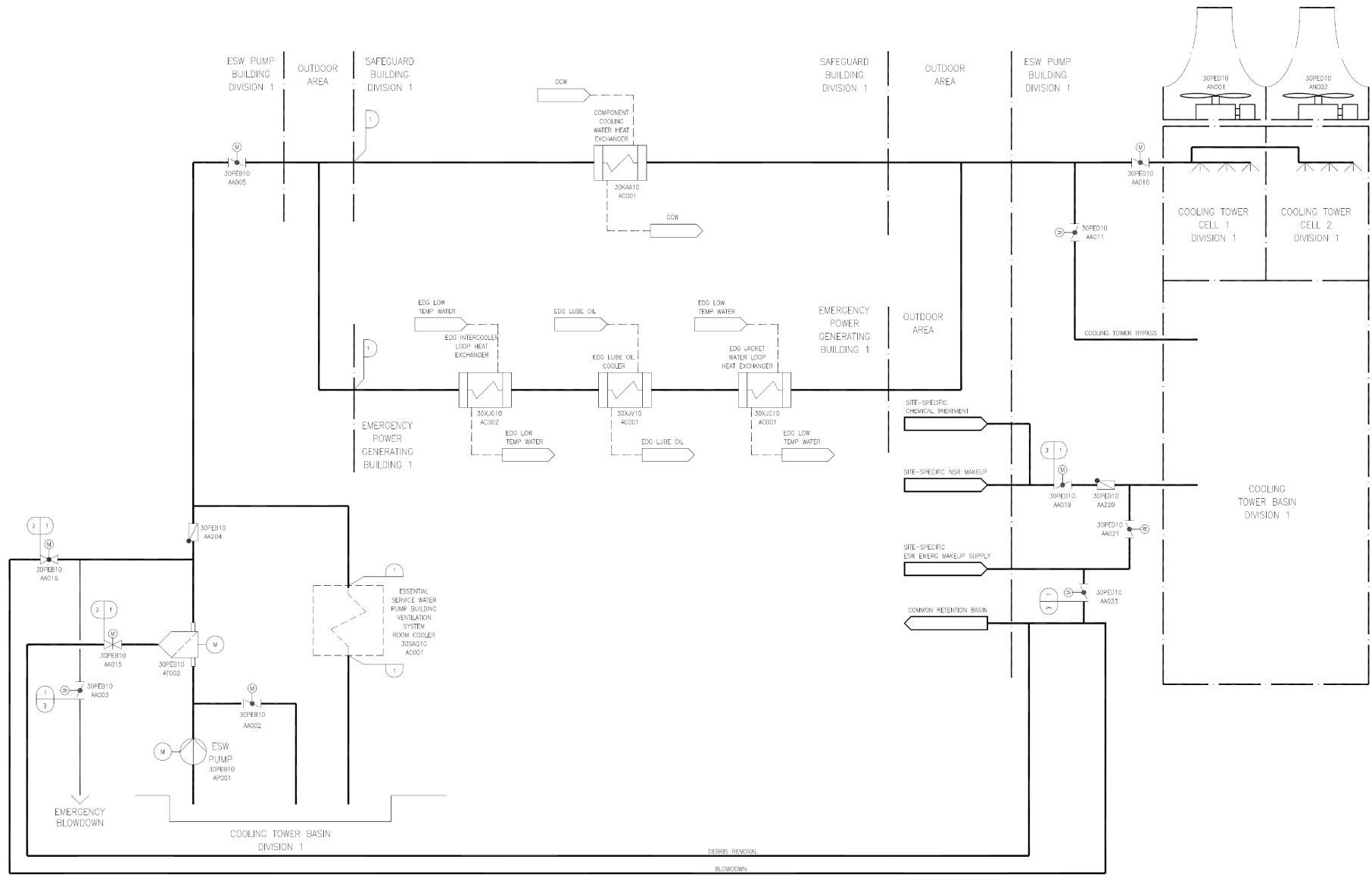
Fig. 5-8 CCWS (1 Train)



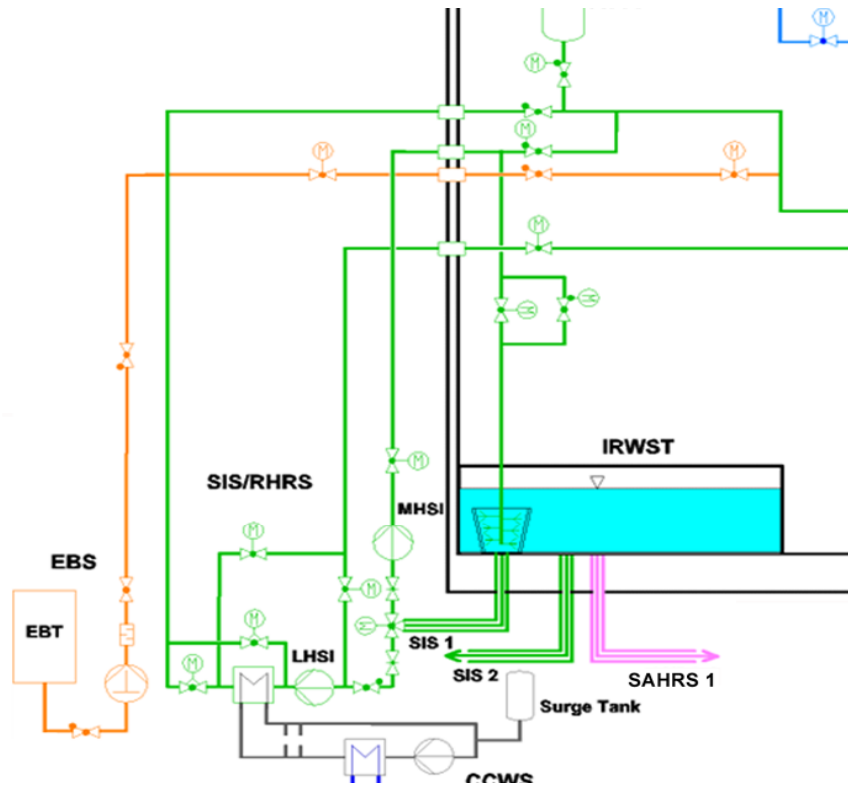
Essential Service Water System

- Cools CCW HXs, EDG HXs, ESW pump room coolers
- At least 2 trains operating
- ESW pumps are in separate ESW buildings with adjacent cooling tower structures
- Nonsafety-related 5th train dedicated to SAHRS cooling

Fig. 5-9 ESWS (1 Train)



Extra Borating System



- Maintains subcriticality during C/D from any transient
- Required to maintain subcriticality after SGTR
- Supports ability to attain cold shutdown using only safety-related systems
- 2 100% trains, each feeds 2 cold legs
- Pumps: 52 gpm (nominal) each
- Tanks: 17,500 gal, 7000 ppm each

Fuel Pool Cooling & Purification System

- Fuel Pool Cooling System (FPCS)
 - Removes decay heat from spent fuel
 - 2 100% trains, each has 2 parallel pumps, 1 HX
- Fuel Pool Purification System (FPPS)
 - Purifies spent fuel pool water; intermittently operated
 - Can be used to purify other pool or tank contents & to transfer water
- Located in fuel building

Fig. 5-11 FPCS (1 Train)

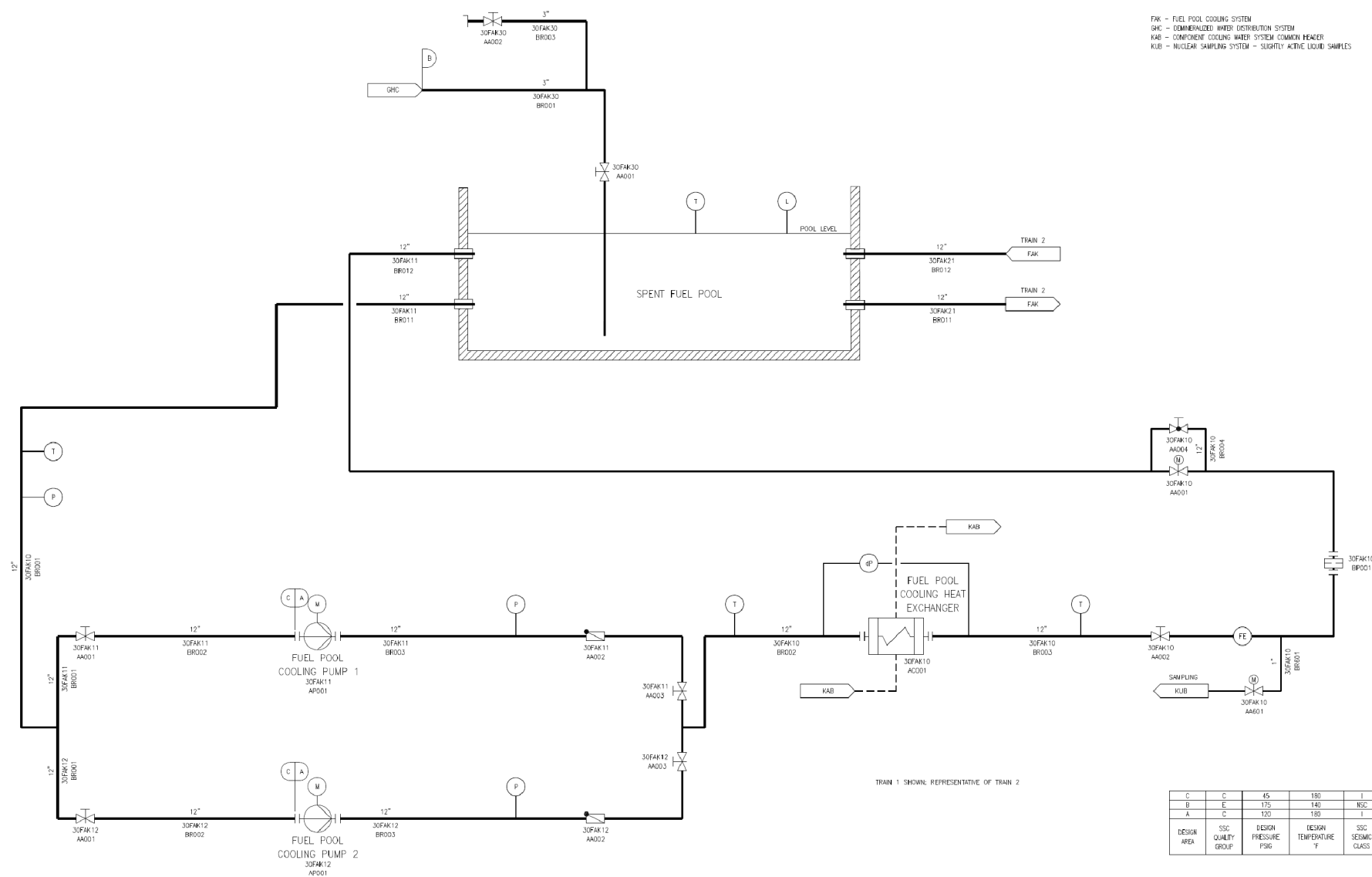


Fig. 5-12 FPFS (Sheet 1)

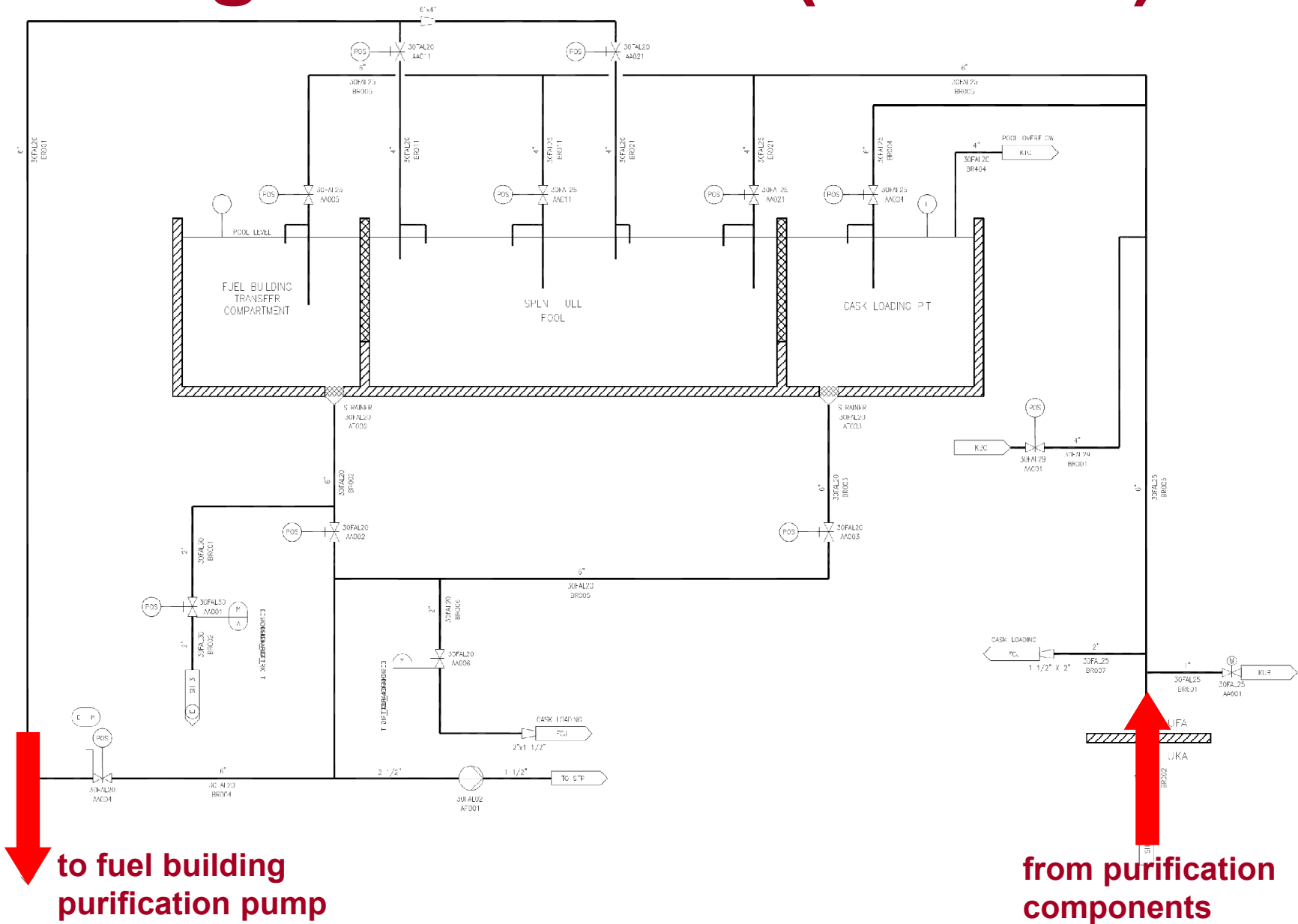


Fig. 5-13 FPPS (Sheet 2)

