4.4 RELIEF AND SAFETY VALVES

4.4.1 Design Basis: The performance objective of the relief and safety valves is to prevent overpressurizing of the reactor vessel. The relief valves also are designed to rapidly depressurize the reactor vessel so that core spray and LPCI systems will function. To achieve these objectives the relief and safety valves were designed using the following bases:

Relief Valves	
Capacity	3,000,000 lb/hr
Pressure Setting	1125 psig
Safety Valves	
† Capacity	5,094,000 lb/hr
Pressure Setting	1210 - 1250 psig

The reactor relief valves are sized to rapidly remove the generated steam flow upon closure of the turbines stop valves and coincident with failure of the turbine bypass system. The relief valves have a sufficiently low pressure setting to eliminate the need for safety valve actuation.

The reactor safety valves are sized to protect the pressure vessel against overpressure during (a) a turbine trip from full power, (b) a failure of the reactor relief valves, (c) a failure of the turbine bypass system. The ASME Boiler and Pressure Vessel Code requires that each vessel designed to meet Section III be protected from the consequence of pressure and temperature in excess of design conditions. The USAS B 31.1 Code for Pressure Piping also requires overpressure protection.

4.4.2 Description

The reactor relief valves are electromatic and are actuated automatically on a high reactor vessel pressure or they can be operated manually from the control room. To add additional protection against a small line break, actuation of the relief valves will occur from coincident signals of low water level, high drywell pressure, and HPCI system low flow. This additional protection is discussed more fully in Section 6.2.4.

The reactor relief valves are located on the steam lines upstream of the first isolation valve and they discharge directly to the pressure suppression pool. There are two independent control systems supplying the signals to all valves to operate and each valve is supplied by separate power circuits. Three of the valves are supplied by one DC power source and two by a different DC power source. However, each valve is backed up by automatic transfer to the other source of DC power upon failure of voltage.

The reactor safety valves are located on the steam lines inside the primary containment. They are balanced, spring-loaded-type safety valves which discharge directly to the drywell atmosphere. The safety valves are the final protection against overpressurizing the vessel and are sized to prevent

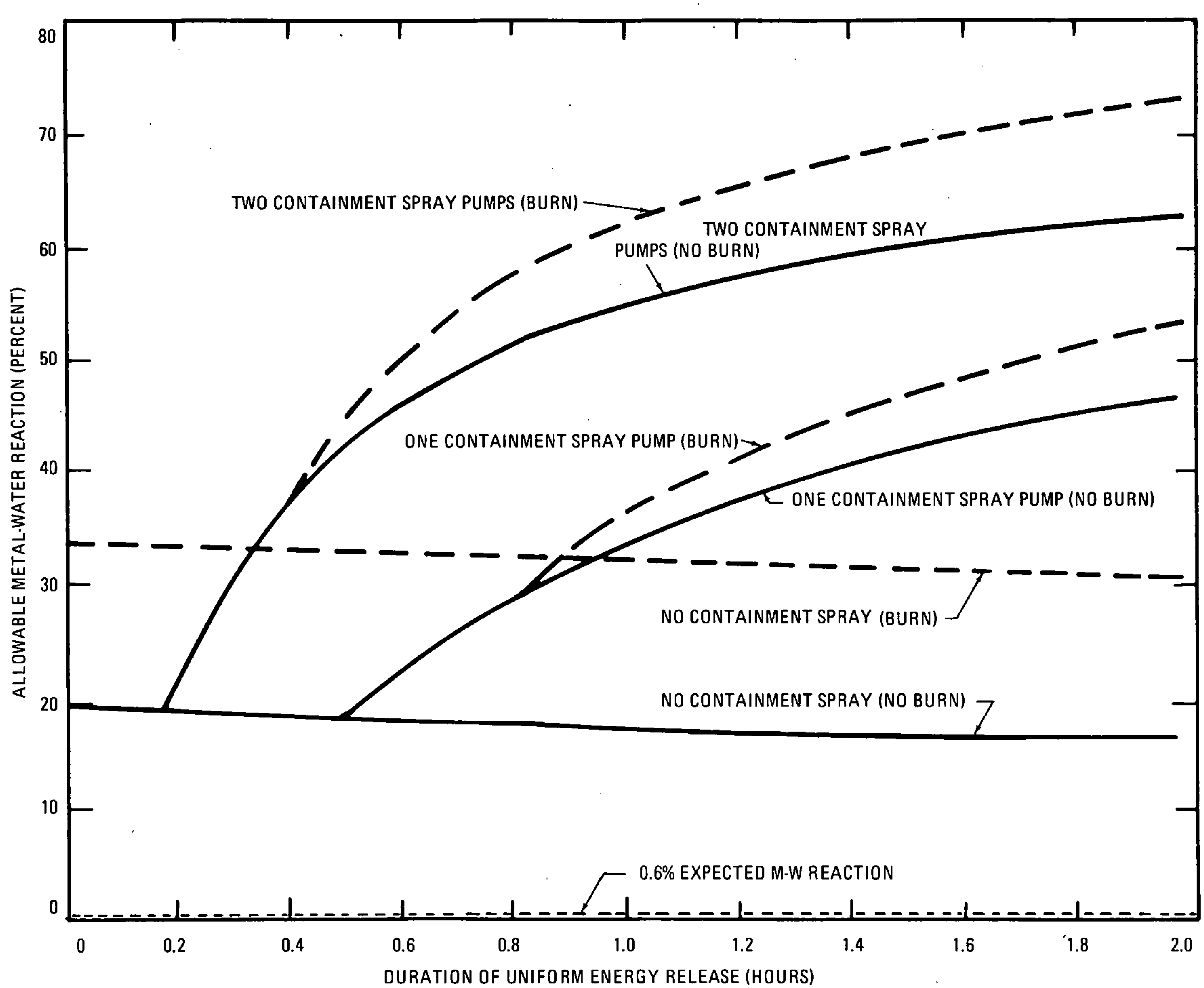

Figure 5.2.16 Containment Capability

line break. Core spray system operation does not produce full flow until the reactor vessel pressure has decreased to 90 psig. The analysis contains the assumption that the systems commence operation 30 seconds after the recirculation-line break. This time is well within the time calculated for the vessel pressure to reach 115 psig as shown in Figure 5.2.16.

This analysis also contains the assumption that only two of the four LPCI pumps in the two containment spray cooling sub-systems are in operation. The heat exchanger associated with these two pumps is assumed to be available for removal of energy from the suppression chamber water. These pumps are assumed to commence operation 400 seconds after the recirculation-line break. The flow rate for this condition is shown in Table 5.2.5.

TABLE 5.2.5

FLOW RATE FOR CONTAINMENT RESPONSE

†

CASE	CONTAINMENT SPRAY*			CORE SPRAY		
	No. of Loops	Pumps Per Loop	Total Flow	No. of Loops	Total Flow	Max. Containment Pressure (psig)
1	1	2	10,000	2	9,000	6.5
2	2	1	20,000	1	4,500	7.6
3	1	2	10,000	1	4,500	6.5
4	1	1	5,000	1	4,500	4.5

*Two Service Water Pumps/HX

The calculated core heatup and extent of metal-water reaction is essentially the same as for operation of only one core spray system as shown in Figure 5.2.11. The total metal-water reaction is less than 0.6 percent. The pressure response of the system is shown as curve "a" in Figure 5.2.11 and the corresponding containment temperature is shown as curve "a" in Figure 5.2.12. After the primary coolant blowdown the drywell and suppression chamber pressures equalize at about 27 psig. Initiation of the containment spray cooling system results in quenching of the steam in the drywell and a corresponding reduction in containment pressure. Energy addition due to core decay heat results in a long-term pressure increase to the maximum shown in Table 5.2.5. Thereafter, energy removal by the containment spray cooling system heat exchanger exceeds the addition rate from all sources, resulting in decreasing containment pressure.

One Core Spray and Four Containment Spray Cooling Pump Operation. For this analysis only one of the two core spray systems is assumed to commence operation 30 seconds after the recirculation-line break. The analysis also assumes that all four pumps of the containment cooling sub-systems commence operation 400 seconds after the recirculation line-break. The flow rates corresponding to these operating conditions are shown in Table 5.2.5.

Core heatup and extent of metal-water reaction are as discussed above for the two-core spray case. It is the same for a single core spray because each of the two independent core spray systems is designed

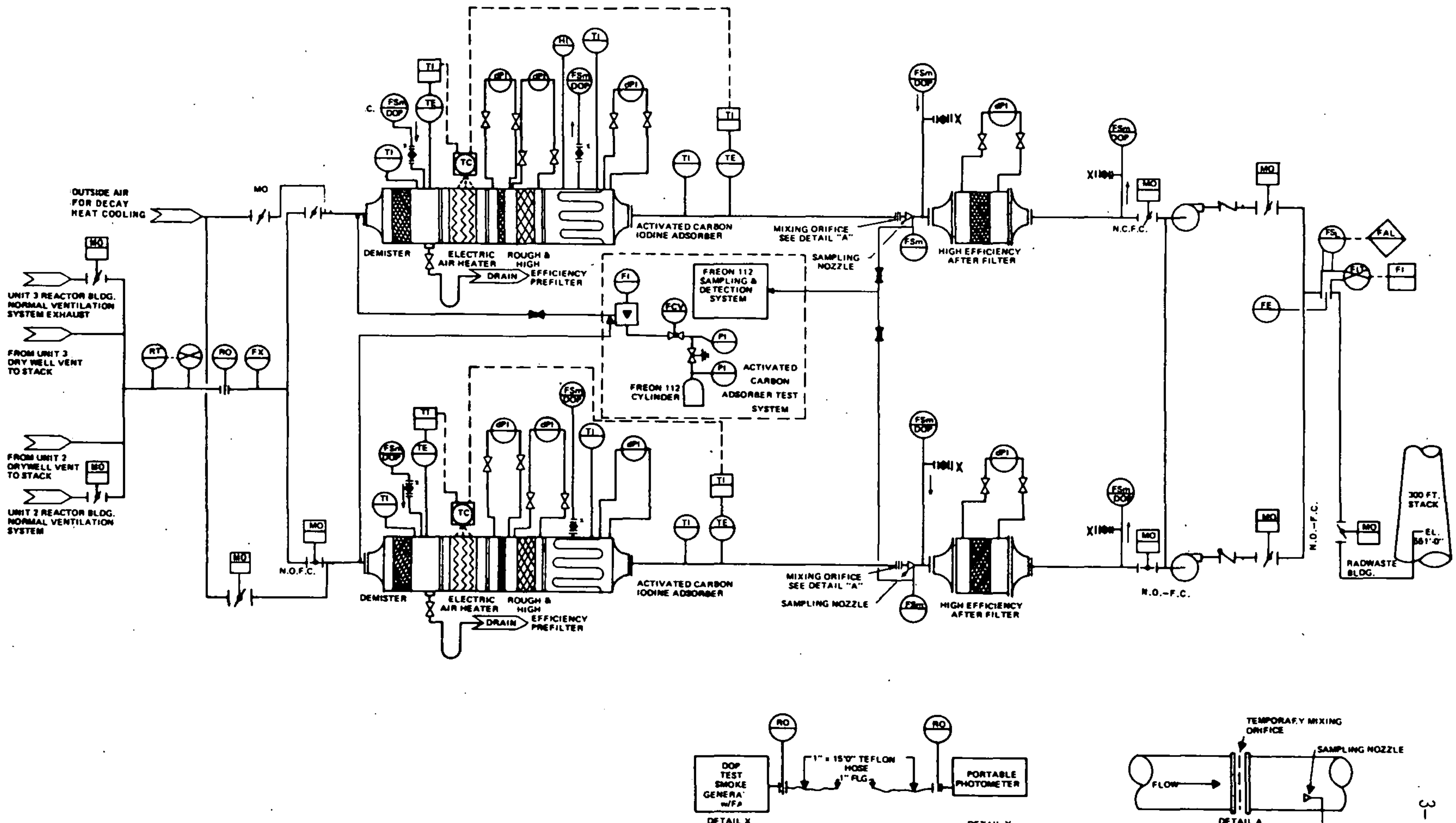

Figure 5.3.2 Standby Gas Treatment System—Diagram

Inside the reactor building between Units 2 and 3 there are ordinary single doors at three floor levels.

Reactor building pipe and electrical penetrations are sealed as necessary to minimize air leakage and meet the infiltration specification. Leakage through minor apertures is acceptable. Electrical penetrations may be caulked with oakum and a soft setting compound, for example. Airflow through pipeways may be blocked sufficiently with sheet metal curtains or collars. Larger annuli may be blocked with appropriate fabric sleeves (e.g., asbestos cloth for hot pipes). Small annuli between pipes and the concrete opening may be left open.

The reactor building ventilation isolation valves are located in the supply and exhaust fan room adjacent to the reactor building at elevation 581' in the turbine building. The two valves in series in the supply duct and the two valves in the exhaust duct close automatically, and the fans shut off, upon detection of high radiation level by the exhaust air monitor (Section 6). The valves may also be operated from the main control room.

The normal ventilation system provides at least one free-volume change of air per hour in the reactor building. Air flows from the filtered supply through ducts to the uncontaminated areas, through potentially contaminated areas, and then through the exhaust fans to the plant stack. Cooling and heating units in various rooms of the reactor building provide for personnel comfort and equipment protection.

Air pressure in the reactor building is automatically controlled at a slight negative pressure (about 0.1 to 0.25 in. water, gage) with the supply air dampers, to assure inleakage of any airborne radioactive contamination, even under high wind conditions.

The standby gas treatment system (Figure 5.3.2) is provided to maintain a small negative pressure in the reactor building under isolation conditions, to prevent ground level escape of airborne radioactivity.
‡ Filters are provided in the system to remove radioactive particulates, and charcoal absorbers are pro-
‡ vided to remove radioactive halogens which may be present in concentrations significant to environmental dose criteria. Any radio-active noble gases passing through the filter/absorbers are diluted with the air and dispersed into the atmosphere from the plant stack. The system is also used to dispose of purge gases from the pressure suppression containment. The exhaust duct radiation monitor provides a continuous indication of radioactivity entering the system, and the stack monitor samples the effluent.

The system is sized to provide one air change per day in the reactor building. Two separate filter/absorber/fan units are provided. If one fan fails to start, as sensed by electrical relays, the other will be started automatically, Both units receive power from the emergency electrical supply. The system is designed for class I seismic conditions. The equipment is located in the shielded center tunnel between the two main condenser rooms. The exhaust pipe runs through the radwaste building and up into the stack.

In the direction of airflow, each standby gas treatment unit has the following major components (Figure 5.3.2):

a. Demister (dehumidifying coil) and reheater to reduce relative humidity to less than 70% at the first high efficiency filter.

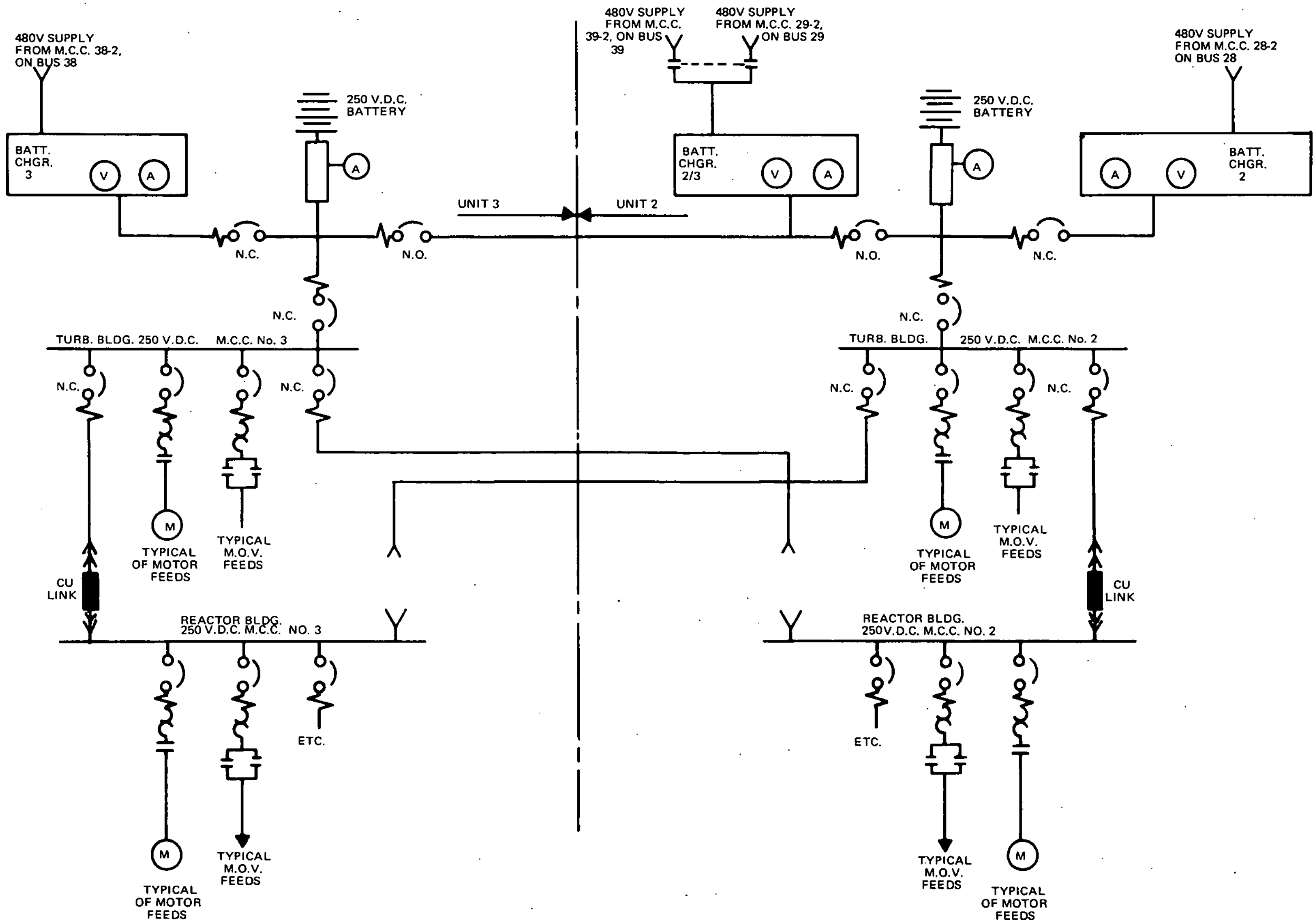

Figure 8.2.6 250v DC Station Battery System

Class I - Critical Equipment

† Nuclear Steam Supply System

- Reactor Vessel
- Reactor Vessel Supports
- Control Rods & Drive System including equipment necessary for scram operation
- Control Rod Drive Housing Supports
- Fuel Assemblies
- Core Shroud
- Core Supports
- Steam Separator
- Steam Dryer
- Recirculating Piping System including valves and pumps
- All piping connections from the Reactor Vessel up to and including the first isolation valve external to the drywell
- Isolation Valves

Isolation Condenser System

Standby Liquid Control System

† Core Spray Systems

† Reactor Building Closed Cooling System

† LPCI/Containment Cooling System

High Pressure Coolant Injection System

Standby Gas Treatment System

† Standby Coolant Supply System

Class II Equipment

Turbine Generator

Condenser

Cranes

Feedwater Heaters and Pumps

Condensate Storage Tanks and Pumps

Auxiliary Power Busses

Reactor Cleanup System

Shutdown Cooling System

Waste Disposal System

Turbine Moisture Separators

Condensate Demineralizer System

Air Compressors and Receivers

All other piping and equipment not listed under Class I.

12.1.1.3 Criteria and Basis for design.

General requirements for the design of all structures and equipment include provisions for resisting the Dead loads, Live loads, and Wind or Seismic loads with impact loads considered part of the Live load. Selection of materials to resist these loads is based on standard practice in the power plant field. Their use is governed by the building codes valid at the site of construction and the experience and knowledge of the designers and builders.

The loads of concern include the following:

D = Dead load of structure and equipment plus any other permanent loads contributing stress, such as soil or hydrostatic loads or operating pressures and live loads expected to be present when the plant is operating.