3E JUSTIFICATION FOR LOAD FACTORS

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APPENDIX 5E

JUSTIFICATION FOR LOAD FACTORS AND LOAD COMBINATIONS USED IN DESIGN EQUATIONS

The load factors and load combinations in the design criteria represent the consensus of the individual judgments of a group of Bechtel engineers and consultants who are experienced in both structural and nuclear power plant design. Their judgment has been influenced by current and past practice, by the degree of conservativeness inherent in the basic loads, and particularly by the probabilities of coincident occurrences in the case of accident, wind, and seismic loads.

The following discussions will explain the justification for the individual factors, particularly as they apply to containment structures.

1.0 DEAD LOAD

Dead load in a large structure such as this is easily identified and its effect can be accurately determined at each point in the vessel. For dead load in combination with accident and seismic or wind loads, a load factor representing a tolerance of 5 percent was chosen to account for dead load inaccuracies. The ACI Code allows a tolerance of +25 percent and -10 percent, but the code was written to cover a variety of conditions where weights and configurations of materials in and on the structure may not be clearly defined and are subject to change during the life of the structure.

2.0 LIVE LOAD

The live load that would be present along with accident, seismic and wind loads would produce a very small portion of the stress at any point. Also, it is extremely unlikely that the full live load would be present over a large area at the time of an unusual occurrence. For these reasons, a low load factor is felt to be justified and live load will be considered together with dead load at a load factor 1.05.

3.0 SEISMIC

The design earthquake that has been selected is considered to be the strongest probable earthquake which could occur during the life of the plant. In addition to the design earthquake, a maximum hypothetical earthquake which defines the maximum credible earthquake which could occur at the site, is considered in design. Class I structures are designed so that no loss of function would result from the maximum hypothetical earthquake. Consequently the probability of an earthquake causing the maximum credible accident is very small. For this reason, the two events, seismic and accident, are con-

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sidered together, but at much lower load factors than those applied to the events separately. The earthquake load factors of 1.25 and 1.0 used in the containment design are conservative for the design and hypothetical earthquakes combination with the factored maximum credible accident.

4.0 WIND

Loads are determined from the fastest wind speed for a 100 year occurrence as shown in Figure 1(b), ASCE Paper No. 3269, "Wind Forces on Structures." With the containment structure designed for this extreme wind, it is inconceivable that the wind would cause an accident. However, as with seismic loads, wind loads will be considered with accident loads, but at reduced load factors which reflect the remote chance of simultaneous occurrence of both extreme load conditions.

5.0 ACCIDENT

The design pressure and temperature are based on the operation of partial safeguards equipment using emergency diesel power.

European practice has been to use a load factor of 1.5 on the design pressure.[1] This factor is reasonable and has been adopted for this design. The probabilities of a maximum accident occurring simultaneously with a maximum wind or seismic disturbance are very small, therefore, a reduced load factor of 1.25 is used for the combination of events.

In all cases the design temperature is defined as that corresponding to the factored pressure. At 1.5P the temperature will be somewhat higher than the temperature at P. It would be unrealistic to apply a corresponding temperature factor of 1.5 since this could only occur with a pressure much greater than a pressure of 1.5P.

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[1]Refer T. C. Waters and N. T. Barrett, "Prestressed Concrete Pressure Vessels for Nuclear Reactor," J. Brit. Nucl. Soc. 2, 1963