5B RHR Injection Flow And Heat Capacity Analysis Outlines

The information in this appendix of the reference ABWR DCD, including all subsections and figures, is incorporated by reference with the following departure.

STD DEP 5B-1

5B.2 Outline For Injection Flow Confirmation

5B.2.3 Beginning Injection Flow

Analysis *- Determine the hydraulic head loss, Hmin, for the LPFL line for the minimum flow mode flowrate, QMin, from the head to flow-squared relationship as follows:*

~~*PMin = HMin + Hs + Hv + 11.55 MPa+ margin*~~

Above equation is replaced by equation listed below

PMin = HMin + Hs + Hv + 1.55 MPa+ margin

Confirmation - *(Convert all terms to consistent units)*

PMin = HMin + Hs + Hv + 1.55 MPa+ margin

5B.2.4 Rated Injection Flow

Analysis - *Determine the hydraulic head loss for the LPFL line at 954 m^3/h, H954, from the head to flow-acquired relationship as follows:*

~~*H954 + (H1 - Hs)(954/Q1)*~~^{2}

Above equation is replaced by equation listed below

$H954 = (H1 - Hs)(954/Q1)^2$

Confirmation - *(Convert all terms to consistent units)*

~~*P954 + H954 + Hs + Hv + 0.27 MPa+ margin*~~

Above equation is replaced by equation listed below

P954 = H954 + Hs + Hv + 0.27 MPa+ margin

5B.3 Outline For Heat Exchanger Confirmation

Analysis

(a) Sizing of the RHR heat exchanger was based on the shutdown cooling ~~*S/P cooling*~~ *needed during a* cooldown to a normal 17-day refueling outage. ~~*feedwater line break LOCA to maintain the S/P temperature below 97°C with any two of three RHR loops operating.*~~ *The result was each loop having the same identical heat exchanger, each*

characterized within an overall heat removal capacity of 4.27 x 10^5 W/°C ~~*370.5 kJ/s°C*~~ *for each loop.*

(b) *The heat removal capacity is specified as* 4.27 x 10^5 W/°C, ~~*370.5 kJ/sec °C,*~~ *which is a constant in the following equation.*

~~*Q, kJ/s = (370.5) (Ti - Tu)*~~

Q, W = (4.27 x 10^5) (Ti - Tu)

Where Ti = Temperature from the Reactor ~~*S/P*~~ *or into the RHR heat exchanger, °C*

Tu = Ultimate heat sink temperature, °C

(c) *For the system design sizing analysis, the heat exchanger capacity was assumed constant over the range of analysis, which covered the* Reactor ~~*S/P*~~ *temperature range of* 28.3°C to 49°C. ~~*43.3°C to 97°C.*~~ *Water from the* Reactor ~~*S/P*~~ *is the input to the RHR heat exchanger, or Ti. The heat exchanger flow rate (*Reactor ~~*S/P*~~ *side, tube side) was assumed constant at 954 m^3/h.*

(d) *The* 4.27 x 10^5 W/°C ~~*370.5 kJ/s °C*~~ *constant characterizes the combined performance of the following equipment, flow conditions, and peripheral heat loads.*

(e) *A detailed analytical heat exchanger and pump design that incorporates the features* ~~*of 4 above*~~ *in an overall integrated solution will be available by the applicant. This detailed analytical model will produce heat removal capacity values equal to or greater than* 4.27 x 10^5 W/°C ~~*370.5 kJ/s°C*~~ *over the same temperature operating range used for the system analysis* (28.3°C to 49°C). ~~*(43.3°C to 97°C).*~~ *This may be a combination of the applicants' own analysis plus the analysis of equipment vendors.*