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SCHWENCER,A. Licensing Branch 2

SUBJECT: Revises 830615 ltr re GDC 51,based on discussions & agreements reached at 830616 meeting.Encl provides lowest svc metal temp values superseding values previously provided.

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Washington Public Power Supply System
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July 7, 1983
G02-83-606

Docket No. 50-397

Director of Nuclear Reactor Regulation
Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
GENERAL DESIGN CRITERION 51

References: (a) G02-82-551, G. D. Bouchey (SS) to A. Schwencer (NRC), same subject, dated June 21, 1982

(b) G02-83-048, G. D. Bouchey (SS) to A. Schwencer (NRC), General Design Criterion 51, Clarification, dated January 18, 1983

This letter is a resubmittal of an editorially revised letter issued originally on June 15, 1983, as G02-83-525. The changes reflected herein resulted from discussions and agreements between Roger Nelson of the Supply System and Joe Halopatz of the NRC in Washington, D.C. on June 16, 1983.

Reference (a) provided the results of a Supply System evaluation for fracture toughness of containment pressure boundary components with respect to GDC 51. The evaluation developed Lowest Service Metal Temperature (LSMT) values for the most limiting pressure boundary components. Reference (b) provided an alternate evaluation to Reference (a) and revised LSMT values for NRC review. Subsequent meetings and correspondence between Supply System personnel and NRC staff have resulted in a re-evaluation of both references. As a result, Attachment 1 is forwarded providing LSMT values that supersede those values provided in References (a) and (b). Of note are the LSMT values for the Reactor Feedwater Isolation Valve RFW V-65A/B body and wedge. In

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support of these LSMT values for RWF V-65A/B Attachment 2, Theoretical Minimum Wall Thickness for Values RFW V-65A/B is provided.

With submittal of Attachments 1) and 2), Supply System compliance with GDC 51 is maintained.

Very truly yours,

G. D. Bouchey
Manager, Nuclear Safety
and Regulatory Program

GDB/TME/cd

cc: R. Auluck - NRC
WS Chin - BPA
RA Feil - NRC 917Q
J. Halopatz - NRC

Equipment Hatch	*LSMT
(PDM DWG's 116, 115, 113, 114)	
Pc. mk. 116 a[R] is 2-1/2" thick, fabricated from SA-537 Gr. B., quenched and tempered material. NUREG 0577 Table 4.4 assigns a ($\overline{NDT} + 2\sigma$) NDT of -60^oF to the material. Summer '77 Addenda, of ASME Class 2 rules assign a Lowest Service Metal Temperature (LSMT) of -30^oF allowing adjustment for thickness.	-30^oF
Pc. mk. 116b is 3" thick, fabricated from SA-516 Gr. 70, quenched and tempered material. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of -10^oF and a LSMT of $+30^oF$, allowing adjustment for thickness.	$+30^oF$
Pc. mk. 113a is 1-1/4" fabricated from SA-516 Gr. 70, normalized material. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of 0^oF and a LSMT of $+30^oF$ to the material allowing adjustment for thickness.	$+30^oF$
Personnel Airlock Assembly	
(PDM DWG's 16, 17, 18, 19, 20, 21, 25)	
Pc. mk's 17a, 17b, 17c, 17pl are 3-1/2" thick, fabricated from SA-516 Gr. 70, quenched and tempered material. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of -10^oF and LSMT of $+35^oF$ to the material allowing adjustment for thickness.	$+35^oF$
Pc. mk. 16a is 2" thick fabricated from SA-516 Gr. 70, normalized material. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of 0^oF and a LSMT of $+30^oF$ to the material allowing adjustment for thickness.	$+30^oF$
Pc. mk. 25a is 2-1/2" thick fabricated from SA-537 Gr. B., quenched and tempered material. NUREG 0577 Table 4.4 assigns a ($\overline{NDT} + 2\sigma$) NDT of -60^oF to the material. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of -30^oF allowing adjustment for thickness.	-30^oF
Drywell Head	
The Drywell Head Flange is 4" thick fabricated from SA-516 Gr. 70, normalized material. Summer '77 Addenda, Class 2 rules assign T_{NDT} of 0^oF and a LSMT of $+50^oF$ to the material allowing adjustment for thickness.	$+50^oF$

*LSMT in this evaluation only applies during hydrostatic testing or leak testing.

Drywell Head (Cont'd.)

The Drywell Head Flange Bolts are manufactured from SA-320 Gr. L43, material. NUREG 0577 states that this material is least susceptible to brittle fracture.

The Drywell Head Flange Nuts are manufactured from SA-194 Gr. 7, material. NUREG 0577 states that this material is least susceptible to brittle fracture.

Flued Heads

Main Steam Flued Heads are manufactured from SA-105 Gr. II, material with a limiting thickness of 4-1/2". NUREG 0577 Table 4.4 assigns a $\overline{NDT}$ of -28°F to normalized C-Mn material. The T_{NDT} of quenched and tempered material can reasonably be expected to lie in the population below -28°F. Given a T_{NDT} of -28°F and a limiting thickness of 4-1/2" the Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +24°F to the material allowing adjustment for thickness. +24°F

Reactor Feedwater Flued Heads are 10" thick manufactured from AS-350 Gr. LF2, quenched and tempered material. NUREG 0577 Table 4.4 assigns a $\overline{NDT}$ of -28°F to normalized material. The T_{NDT} of quenched and tempered material can reasonably be expected to lie in the population below -28°F. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of +52°F to the material allowing adjustment for thickness. +52°F

Containment Penetration Limiting Materials

The Main Steam and Reactor Feedwater penetration nozzles are 2" thick fabricated from SA-155 KCF 70, Class 1, normalized material. Summer '77, of ASME Class 2 rules assign a T_{NDT} of 0°F and a LSMT of +30°F to the material allowing adjustment for thickness. +30°F

Penetration X-119 is 24" x 1.219" wall, is fabricated from SA-333 Gr. 6, material. This material was Cv tested at -50°F to criteria consistent with Summer '77 Addenda, of ASME Class 2 rules. ∿-50°F

Penetration X-45 is 16" x .844 wall, is fabricated from SA-333 Gr. 1, material. This material was Cv tested at -50°F to criteria consistent with Summer '77 Addenda, of ASME Class 2 rules. ∿-50°F

Containment Penetration Limiting Materials (cont'd.)

Penetration X-55 has a closure plate typical of spare penetrations. The plates are SA-516 Gr. 70, normalized material, 1" thick. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of 0°F and a LSMT of +30°F to the material allowing adjustment for thickness. +30°F

Reactor Feedwater Check Valves

(RFW 32A typ)

The valve body minimum design thickness is 2.28" and is fabricated from SA-216 WCB normalized, quenched and tempered material. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of +30°F and a LSMT of +60°F to the material allowing adjustment for thickness. +60°F

The valve disc minimum design thickness is 2.28" and is fabricated from SA-352 LCB normalized and tempered material. NUREG 0577 Table 4.4 would categorize the material on the basis of chemistry as comparable to A-216. The NUREG identifies a ($\overline{NDT} + 1.3\sigma$) NDT of +57°F for the material. Assuming a T_{NDT} of 57°F Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +87°F to the material allowing adjustment for thickness. +87°F

The valve bonnet minimum design thickness is 4-15/16" and is manufactured from SA-516 Gr. 70, normalized material. Summer '77 Addenda, of ASME Class 2 rules assign a T_{NDT} of 0°F and a LSMT of 55°F to the material allowing adjustment for thickness. +55°F

The bolts and nuts used in assembling the valve are SA-193 B7 and SA-194 2H respectfully. NUREG 0577 Table 4.6 categorizes the material as having the least susceptibility to failure.

Reactor Feedwater Subassembly

The only material over 5/8" thick requiring review in the subassembly is the large bore pipe which is SA-106 Gr. B, normalized material 1.812" thick. Given the data in NUREG 0577, Fig. B7, it is reasonable to assume that the T_{NDT} of this material would lie in population below $\overline{NDT}$ of +27°F. Given T_{NDT} of +27°F, Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +57°F to the material allowing adjustment for thickness. +57°F

Reactor Feedwater Isolation Valves (Typ)(RFW-V-65A/B)

The valve body minimum design thickness is 2.4" and is manufactured from SA-352 Gr. LCB, normalized material. NUREG 0577 Table 4.4 would categorize the material on the basis of chemistry, as comparable to A-216. Given the data in NUREG 0577, Fig. B.2, it is reasonable to assume that the T_{NDT} of this material will lie in the population below the $(\overline{NDT} + 1.3\sigma)$ NDT of +57°F. Assuming a T_{NDT} of 57°F, Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of 87°F to the material allowing adjustment for thickness. +87°F

The wedge limiting theoretical minimum thicknesses based on RPV hydro test pressure of 1563 PSIG and ANSI hydro test pressure 3020 PSIG are 1.92" and 2.69" respectively. The thickness of 2.69" was used to determine the LSMT. The wedge is manufactured from SA-352 Gr. LCB, normalized and tempered material. NUREG 0577 Table 4.4 would categorize the material on the basis of chemistry, as comparable to A-216. Assuming a T_{NDT} of 57°F Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of 89°F to the material allowing adjustment for thickness. 89°F

The bonnet minimum design thickness is 2.4" and is manufactured from SA-350 Gr. LF2, quenched and tempered material. The material is categorized as C-Mn in NUREG 0577. NUREG 0577 Table 4.4 assigns a $\overline{NDT}$ of -28°F to normalized material. The T_{NDT} of quenched and tempered material can reasonably be expected to lie in the population below -28°F. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of +2°F to the material allowing adjustment for thickness. +2°F

Main Steam Isolation Valves (Typ)

The body's minimum design thickness is 1.58" and is manufactured from SA-216 WCB, normalized, quenched and tempered material. Summer 77 Addenda, of ASME Class 2 rules assign a T_{NDT} of +30°F and a LSMT of +60°F allowing adjustment for thickness. +60°F

The bonnet minimum design thickness 7.66" and is manufactured from SA-105 Gr., II, normalized and tempered material. NUREG 0577 Table 4.4 assigns a $(\overline{NDT} + 1.3\sigma)$ NDT of -5°F to the material. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of +65°F to the material allowing adjustment for thickness. +65°F

The disc's minimum design thickness is 5.5" and is manufactured from SA-182 Gr. F11, normalized and tempered material. Data for material of comparable chemistry, presented in Figure 24 of ASM Metals Handbook, Ninth Edition, Volume 1, page 702, would +53°F

infer for this material a T_{NDT} below 32°F. Given its alloy content, its microstructure resulting from normalizing and tempering would be expected to favor a toughness characterization comparable to that of SA-105 to which NUREG 0577 Table 4.4 assigns a $(\overline{NDT} + 1.3\sigma)$ NDT of -5°F. Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +53°F to the material allowing adjustment for thickness.

The stem disc minimum design thickness is 1.56" and is manufactured from SA-182 Gr. F11. Using the same analysis as for the disc, Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +25°F to the material allowing adjustment for thickness. +25°F

The bolts and nuts used in assembling of the Main Steam Isolation Valves are SA-193 Gr. B7 and SA-194 Gr. 7, respectfully. NUREG 0577 classifies these as least susceptible to brittle fracture.

TABLE
THEORETICAL MINIMUM WALL THICKNESS FOR
VALVES RFW-V-65A/B

BASED ON HYDRO TEST PRESSURES

	Theoretical[b] Min. Thickness t_m (inches)	Theoretical[c] Min. Thickness t_m (inches)	Actual Min. Thickness t (inches)	Safety Ratio[b] t/t_m	Safety Ratio[c] t/t_m
Body (Weld Ends)[d][e]	0.78	1.54	2.4	3.08	1.56
Body (Gate Cavity)[d][e]	1.20	2.34	3.1	2.58	1.32
Wedge[f][e]	1.92	2.69	5.13	2.67	1.90

(a) This is the results of an informal calculation provided for information only. The author will retain the calculation in his personal files

(b) Based on RPV hydro test pressure of 1563 psig

(c) Based on RFW-V-65A/B upstream (FW pump-side) hydro test pressure of 3070 psig.

(d) Lame stress formulation

(e) S_m = 23.3 Ksi @ 100°F -- SA352 - LCB

(f) Plate bending stresses; stress intensity limit is 1.5 (S_m) (Roark, 4th edition, page 217, case 6)

Attachment 2

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