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 SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards info re General Design Criterion 51, including lowest svc metal temp for equipment hatch, personnel airlock assembly, drywell head, flued heads & MSIVs. Encl info should close out Item 25 of SER (NUREG-0892).

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1. The first part of the report is a general introduction to the subject.

2. The second part is a detailed description of the methods used.

3. The third part is a discussion of the results obtained.

4. The fourth part is a conclusion.

5. The fifth part is a list of references.

Washington Public Power Supply System

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June 21, 1982
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Docket No. 50-397

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

Enclosed are sixty (60) copies of the information on General Design Criterion 51. This information should close out open item number 25 as listed in NUREG-0892, WNP-2 Safety Evaluation Report.

Very truly yours,



G. D. Bouchey
Deputy Director, Safety and Security

CDT/jca
Enclosure

cc: R Auluck - NRC
WS Chin - BPA
R Feil - NRC Site

13001

The material used in fabricating the WNP-2 containment vessel has been reviewed and evaluated to the requirements of Section III, subsection NC, Summer '77 Addenda of the ASME Code. Every containment penetration nozzle over 5/8" thick has been reviewed, and the penetrations containing the greatest material thickness were evaluated to this section of the ASME Code. Summer 1977 Addenda of the Code, when combined with data available in NUREG 0577, allows one to develop a lowest service metal temperature (LSMT) that a material can be exposed to, to prevent brittle fracture, when impact data on the material is not available. The attached pages contain this evaluation.

The lowest service metal temperature should be that limiting temperature under the conditions cited by GDC 51 (operating, maintenance, testing, and postulated accident conditions) during which the material is called upon to provide a pressure boundary during the performance of the containment function.

The following is an evaluation of temperatures which will be observed by the limiting material during the conditions cited in GDC 51.

During operation or hot standby of the plant, the Main Steam and Reactor Feedwater penetrations are at a temperature well above the lowest service metal temperature identified on the attached sheets. The normal temperature within the containment drywell is 135°F. Also the steam and feedwater lines are at temperatures above 400°F which will keep the temperatures in the area around the penetrations warmer than 135°F.

During maintenance: At cold shutdown, the plant is not operating, and there are no systems available which can provide pressure to the containment vessel requiring the material to provide a pressure boundary for containment function. The minimum temperature in the containment drywell is not expected to be below 70°F.

During postulated accident and testing conditions, the following occur.

- a) During postulated accident conditions, the systems and penetrations will be at operating temperatures which are well above the lowest service metal temperatures. The operation temperatures in containment drywell is 135°F.
- b) Hydrostatic testing has been determined to be the limiting condition to meet the requirements of GDC 51. At this time, the R.F.W. and M.S. isolation valves, which contain the limiting materials, will be hydrostatically tested at the same time as the Reactor Pressure Vessel. The temperature for hydrostatic testing of the Reactor Pressure Vessel will be a minimum of 130°F.

Equipment Hatch

LSMT

(PDM DWG's 116, 115, 113, 114)

Pc. mk. 116 aR is 2 1/2" thick, fabricated from SA-537 Gr. B., quenched and tempered material. NUREG 0577 Table 4.4 assigns a ($NDT + 2\sigma$) NDT of -60°F to the material. Summer '77 Addenda, of ASME Class 2 rules assign a Lowest Service Metal Temperature (LSMT) of -30°F allowing adjustment for thickness. -30°F

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°F and a LSMT of +30°F, allowing adjustment for thickness. +30°F

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°F and a LSMT of +30°F to the material allowing adjustment for thickness. +30°F

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°F and LSMT of +35°F to the material allowing adjustment for thickness. +35°F

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°F and a LSMT of +30°F to the material allowing adjustment for thickness. +30°F

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 ($NDT + 2\sigma$) NDT of -60°F to the material. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of -30°F allowing adjustment for thickness. -30°F



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Drywell Head

LSMT

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 $0^{\circ}F$ and a LSMT of $+500^{\circ}F$ to the material allowing adjustment for thickness.

$+500^{\circ}F$

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 NDT of $-280^{\circ}F$ to normalized C-Mn material. The T_{NDT} of quenched and tempered material can reasonably be expected to lie in the population below $-280^{\circ}F$. Given a T_{NDT} of $-280^{\circ}F$ and a limiting thickness of 4 1/2" the Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of $+240^{\circ}F$ to the material allowing adjustment for thickness.

$+240^{\circ}F$

Reactor Feedwater Flued Heads are 10" thick manufactured from SA-350 Gr. LF2, quenched and tempered material. NUREG 0577 Table 4.4 assigns a NDT of $-280^{\circ}F$ to normalized material. The T_{NDT} of quenched and tempered material can reasonably be expected to lie in the population below $-280^{\circ}F$. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of $+520^{\circ}F$ to the material allowing adjustment for thickness.

$+520^{\circ}F$

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 $0^{\circ}F$ and a LSMT of $+300^{\circ}F$ to the material allowing adjustment for thickness.

$+300^{\circ}F$

Penetration X-119 is, 24" x 1.219" wall, is fabricated from SA-333 Gr. 6, material. This material was Cv tested at $-500^{\circ}F$ to criteria consistent with Summer '77 Addenda, of ASME Class 2 rules.

$-500^{\circ}F$

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Containment Penetration Limiting Materials (cont'd.)

LSMT

Penetration X-45 is, 16" x .844 wall, is fabricated from SA-333 Gr. 1, material. This material was Cv tested at -500F to criteria consistent with Summer '77 Addenda, of ASME Class 2 rules.

-500F

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 +300F to the material allowing adjustment for thickness.

+300F

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 +300F and a LSMT of +600F to the material allowing adjustment for thickness.

+600F

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 NDT of +350F for material 2 1/2" - 5" thick. Assuming a T_{NDT} of 350F Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +650F to the material allowing adjustment for thickness.

+650F

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 550F to the material allowing adjustment for thickness.

+550F

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

LSMT

The only material over 5/8" thick requiring review in the subassembly is the large bore pipe which is SA-106 Gr. B, normalize material 1.812" thick. NUREG 0577 Table 4.4 assigns a (NDT + 1.3 σ) of 670F. Summer '77 Addenda, of ASME rules would assign a LSMT of 970F to the material allowing adjustment for thickness. However Figure B7 in NUREG 0577 shows that a NDT temperature of SA-106 Gr. B, normalize material is in the range of -200F. Therefore LSMT of 970F is ultraconservative and a LSMT of 700F would be acceptable.

700F

Reactor Feedwater Isolation Valves (Typ)

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. The NUREG identifies a NDT of +350F for material 2 1/2" - 5" thick. Assuming a T_{NDT} of 350F, Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +650F to the material allowing adjustment for thickness.

+650F

The wedge minimum design thickness is 5.125" and is manufactured from SA-352 Gr. LCB, normalized and annealed material. NUREG 0577 Table 4.4 would categorize the material on the basis of chemistry, as comparable to A-216. The NUREG identifies a NDT of +350F for material 2 1/2" - 5" thick. Assuming a T_{NDT} of 350F. Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +900F to the material allowing adjustment for thickness.

+900F

The bonnet minimum design thickness is 2.4" and is manufactured from SA-350 Gr. LF2, quenched and tempered material. NUREG 0577 Table 4.4 assigns a NDT of -280F to normalized material. The T_{NDT} of quenched and tempered material can reasonably be expected to lie in the population below -280F. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of +20F to the material allowing adjustment for thickness.

+20F

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 +300F and a LSMT of +600F allowing adjustment for thickness.

+600F

Main Steam Isolation Valves (Typ) (cont'd.)

LSMT

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 -50F to the material. Summer '77 Addenda, of ASME Class 2 rules assign a LSMT of +650F to the material allowing adjustment for thickness.

+650F

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 infer for this material a T_{NDT} below 320F. 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 -50F. Summer '77 Addenda, of ASME Class 2 rules would assign a LSMT of +530F to the material allowing adjustment for thickness.

+530F

The steam 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 +250F to the material allowing adjustment for thickness.

+250F

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 fracture.

