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Southern Nuclear Operating Company
the southern electric system

July 1, 1992

10 CFR 50.54(f)

Docket Nos. 50-348
50-364

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Joseph M. Farley Nuclear Plant
Generic Letter 92-01, Reactor Vessel Structural Integrity

Gentlemen:

On February 28, 1992 the NRC issued Generic Letter (G.L.) 92-01, "Reactor Vessel Structural Integrity" which was subsequently replaced by Revision 1 dated March 6, 1992. The stated purpose of this generic letter is to obtain information needed to assess compliance with requirements and commitments regarding reactor vessel integrity in light of events associated with Yankee Nuclear Power Station. In G.L. 92-01, the NRC requested information regarding compliance with the requirements of 10 CFR 50.60 and 50.61 and commitments made in response to G.L. 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Impact on Plant Operations." Specific responses to each of the requests listed in G.L. 92-01 for Farley Nuclear Plant Units 1 and 2 are provided as Attachments 1 and 2, respectively.

In summary, Southern Nuclear Operating Company has reviewed the requirements and commitments related to reactor vessel structural integrity and has verified continued compliance. It should be noted that the information provided in Attachments 1 and 2 was extracted from the material certification reports provided by the manufacturer of the reactor vessels and is the most accurate available to Southern Nuclear Operating Company.

If there are any questions, please advise.

Respectfully submitted,

J. D. Woodard

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 1st DAY OF July, 1992

Debra A. Barnett
Notary Public

9-14-94

JDW/BHW:map 2531
Attachments
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ATTACHMENT 1

JOSEPH M. FARLEY UNIT 1

RESPONSE TO

GENERIC LETTER 92-01

1. NRC Request

Addressees who do not have a surveillance program meeting ASTM E 185-73, -79, or -82 and who do not have an integrated surveillance program approved by the NRC, are requested to describe actions taken or to be taken to ensure compliance with Appendix H to 10 CFR Part 50.

SNC Response

As stated in NUREG-75/034, "Safety Evaluation Report Joseph M. Farley Nuclear Plant Units 1 and 2," dated May 2, 1975, the toughness properties of the reactor vessel beltline material will be monitored throughout service life in accordance with the requirements of ASTM E-185-73 and 10 CFR Part 50, Appendix H. The SER concludes that the reactor vessel material surveillance program constitutes an acceptable basis for monitoring radiation induced changes in the future toughness of the reactor vessel material, and satisfies the requirements of General Design Criterion 31 of 10 CFR Part 50.

2. NRC Request

Addressees of plants for which the Charpy upper shelf energy is predicted to be less than 50 foot-pounds at the end of their licenses using the guidance in Paragraphs C.1.2 or C.2.2 in Regulatory Guide 1.99, Revision 2, are requested to provide to the NRC the Charpy upper shelf energy predicted for December 16, 1991, and for the end of their current license for the limiting beltline weld and the plate or forging and are requested to describe the actions taken pursuant to Paragraphs IV.A.1 or V.C of Appendix G to 10 CFR Part 50.

SNC Response

Table 1 contains the 32 EFPY Charpy upper shelf energy for Farley Unit 1 beltline materials. The calculated 32 EFPY Charpy upper shelf energy for all the beltline region plates are predicted to be above the 50 foot-pound criteria.

TABLE 1
J. M. FARLEY UNIT 1
CALCULATED 32 EFPY UPPER SHELF ENERGY

MATERIAL DESCRIPTION	EOL USE (Ft-Lbs)
Inter. Shell, B6903-2	71.8
Inter. Shell, B6903-3	66
Lower Shell, B6919-1	61.92
Lower Shell, B6919-2	61.92
Inter. Shell Long. Welds	(a)
Lower Shell Long. Welds	(a)
Inter./Lower Circ. Weld	(a)
Surveillance Weld	98.34

(a) No estimate since upper shelf energy values are not available because unirradiated Charpy V-notch impact tests were not performed.

3. NRC Request

Addressees whose reactor vessels were constructed to an ASME Code earlier than the Summer 1972 Addenda of the 1971 Edition are requested to describe the consideration given to the following material properties in their evaluations performed pursuant to 10 CFR 50.61 and Paragraph III.A of 10 CFR Part 50, Appendix G:

(1) the results from all Charpy and drop weight tests for all unirradiated beltline materials, the unirradiated reference temperature for each beltline material, and the method of determining the unirradiated reference temperature from the Charpy and drop weight test;

(2) the heat treatment received by all beltline and surveillance materials;

(3) the heat number for each beltline plate or forging and the heat number of wire and flux lot number used to fabricate each beltline weld;

(4) [illegible] number for each surveillance plate or forging and the heat number of [illegible] flux lot number used to fabricate the surveillance weld;

[illegible] [illegible] composition, in particular the weight in percent of copper, nickel, [illegible]s, and sulfur for each beltline and surveillance material; and

[illegible] number of the wire used for determining the weld metal chemical [illegible]on if different than Item (3) above.

SNC Response

The J. M. Farley Unit 1 reactor vessel was constructed to the 1970 Summer Addenda to Section III of the ASME Code. Thus, the J. M. Farley Unit 1 reactor vessel was constructed to an ASME Code earlier than the Summer 1972 Addenda of the 1971 Edition. Tables 2 through 12 document the unirradiated data (Charpy and drop weight test results, reference temperature, upper shelf energy), heat treatment, heat numbers, weld flux lot number, and chemical composition for all beltline region and surveillance materials. These values were developed using the current reactor pressure vessel material test requirements and acceptance standards at the time of fabrication.

ATTACHMENT 1

TABLE 2

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on June 19, 1970.

Component: Intermediate Shell Plate, B6903-2 Heat No.: C6294-1

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.20	1.32	0.011	0.013	0.21	0.60	0.55	0.13	0.017	0.015

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	31	10	23
- 40	28	10	20
- 40	19	0	17
+ 10	85	40	61
+ 10	93	45	64
+ 10	96	45	70
+ 40	96	45	65
+ 40	105	50	70
+ 40	103	50	66
+110	141	99	91
+110	135	95	90
+110	132	85	86
+160	153	100	88
+160	155	100	88
+160	147	100	87

Temp. °F	Drop Weights	NDT
- 20	1-F	
- 10	1-F	
0	1-F 1-NF	0°F
+ 10	2-NF	

Heat Treatment

1550-1650°F, 4 hours. Water quenched.
1125°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on June 19, 1970.

Component: Intermediate Shell Plate, B6903-2 Heat No.: C6294-1

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.20	1.32	0.011	0.013	0.21	0.60	0.55	0.13	0.017	0.015

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	31	10	23
- 40	28	10	20
- 40	19	0	17
+ 10	85	40	61
+ 10	93	45	64
+ 10	96	45	70
+ 40	96	45	65
+ 40	105	50	70
+ 40	103	50	66
+110	141	99	91
+110	135	95	90
+110	132	85	86
+160	153	100	88
+160	155	100	88
+160	147	100	87

Temp. °F	Drop Weights	NDT
- 20	1-F	
- 10	1-F	
0	1-F 1-NF	0°F
+ 10	2-NF	

Heat Treatment

1550-1650°F, 4 hours. Water quenched.
1125°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on June 19, 1970.

Component: Intermediate Shell Plate, B6903-3 Heat No.: C6308-2

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.21	1.29	0.014	0.015	0.16	0.56	0.56	0.12	0.019	0.023

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 80	12	0	15
- 80	8	0	10
- 40	43	15	30
- 40	23	10	16
- 40	50	20	36
+ 10	65	25	49
+ 10	90	40	62
+ 10	66	25	47
+ 40	72	30	56
+ 40	96	45	62
+ 40	81	35	56
+110	109	85	78
+110	126	90	80
+160	132	100	84
+160	137	100	90

Temp. °F	Drop Weights	NDT
0	1-F	
+ 10	1-F	+10°F
+ 20	2-NF	

Heat Treatment

1550-1650°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on July 30, 1970.

Component: Lower Shell Plate, B6919-1 Heat No.: C6940-1

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	[illegible]	Co
0.20	1.39	0.015	0.015	0.18	0.55	0.56	0.14	0.025	0.008

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 80	9	0	15
- 80	6	0	6
- 40	42	20	30
- 40	27	15	21
+ 10	82	40	61
+ 10	62	30	48
+ 10	58	25	44
+ 40	77	40	58
+ 40	80	40	60
+ 40	87	45	62
+110	116	80	82
+110	140	100	86
+110	123	100	84
+160	130	100	87
+160	136	100	88

Temp. °F	Drop Weights	NDT
- 20	1-F	
- 10	2-NF	- 20°F
0	1-NF	

Heat Treatment

1550-1650°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on July 30, 1970.

Component: Lower Shell Plate, B6919-2 Heat No.: C6697-2

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.20	1.39	0.015	0.018	0.19	0.56	0.53	0.14	0.018	0.010

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 80	11	0	4
- 80	7	0	3
- 40	45	20	34
- 40	30	15	23
+ 10	67	30	49
+ 10	67	30	50
+ 10	57	25	40
+ 40	84	40	60
+ 40	86	40	63
+ 40	81	35	58
+110	111	90	87
+110	112	80	82
+110	132	100	88
+160	135	100	82
+160	133	100	84

Temp. °F	Drop Weights	NDT
- 20	1-F	
- 10	1-F	-10°F
0	2-NF	

Heat Treatment

1550-1650°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

TABLE 6

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on October 19, 1971.

Component: Intermediate to Lower Shell Circle Seam, 11-894

Weld Wire: Type B4, Heat No. 6329637 Flux: Linde 0091, Lot No. 3999

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cu
0.14	1.15	0.011	0.014	0.19	0.53	0.24

Charpy Impact Tests

Temp. °F	Ft-Lbs	NDT °F
+ 10	101	
+ 10	108	0 (a)
+ 10	103	

(a) Estimated per NRC Standard Review Plan Section 5.3.2

Heat Treatment

1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on October 27, 1969.

Component: Intermediate Shell Long. Seams, 19-894A&B

Weld Wire: Type B4, Heat No. 33A277 Flux: Linde 1092, Lot No. 3889

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cu
0.11	1.27	0.015	0.010	0.14	0.49	0.27

Charpy Impact Tests

Temp. °F	Ft-Lbs	NDT °F
+ 10	103	
+ 10	105	0 (a)
+ 10	108	

(a) Estimated per NRC Standard Review Plan Section 5.3.2

Heat Treatment

1125°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on October 7, 1970.

Component: Lower Shell Long. Seams, 20-894A&B

Weld Wire: Type B4, Heat No. 90099 Flux: Linde 0091, Lot No. 3977

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cu
0.15	1.12	0.022	0.012	0.23	0.49	0.17

Charpy Impact Tests

Temp. °F	Ft-Lbs	NDT °F
+ 10	56	
+ 10	30	0 (a)
+ 10	52	

(a) Estimated per NRC Standard Review Plan Section 5.3.2

Heat Treatment

1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 1
Surveillance Capsule Materials Data

The following information was taken from WCAP-8810, "Alabama Power Company Joseph M. Farley Nuclear Plant Unit No. 1 Reactor Vessel Radiation Surveillance Program," December 1976.

Component: Surveillance Material SA533 Grade B Class 1 plate used in the core region lower shell plate, B6919-1.

Chemical Analysis
Lower Shell Plate, B6919-1

Chemical analyses were performed by both Combustion Engineering and Westinghouse. The results of both analyses are given below.

Element	Combustion Engineering Analysis	Westinghouse Analysis
C	0.20	---
S	0.015	0.013
N	---	0.00?
Co	0.008	0.016
Cu	0.14	0.10
Si	0.18	0.28
Mo	0.56	0.51
Ni	0.55	0.56
Mn	1.39	1.40
Cr	---	0.13
V	---	<0.001
P	0.015	0.015
Sn	---	0.008
Al	0.025	---

Heat Treatment
Lower Shell Plate, B6919-1

1550°F/1650°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Dropweight Tests
Lower Shell Plate, B6919-1

The nil-ductility transition temperature (NDTT) was determined for plate B6919-1 to be -20°F by drop weight tests (ASTM E-208) performed by Combustion Engineering.

TABLE 9 continued

Charpy Impact and Fracture Tests
Lower Shell Plate, B6919-1 (Longitudinal)

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 50	26	14	18
- 50	12	10	8
- 50	11	14	8
0	59	30	44
0	48	27	37
0	56	27	38
+ 40	80	50	62
+ 40	52	35	44
+ 40	68	42	53
+ 80	107	80	70
+ 80	100	80	73
+ 80	106	80	71
+130	135	100	80
+130	140	100	90
+130	145	100	88
+210	131	100	83
+210	129	100	85
+210	142	100	85

TABLE 9 continued

Charpy Impact and Fracture Tests
Lower Shell Plate, B6919-1 (Transverse)

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	12	14	7
- 40	25	14	17
- 40	29	20	18
0	30	25	21
0	27	25	24
0	35	25	26
+ 40	26	37	26
+ 40	37	29	30
+ 40	44	52	37
RT	60	55	50
RT	53	64	45
RT	53	50	46
+110	75	77	56
+110	69	79	53
+110	80	90	52
+210	92	100	71
+210	91	100	72
+210	89	100	68

Joseph M. Farley Unit 1
Surveillance Capsule Materials Data

Component: Surveillance Weld Material made from sections of lower shell plate, B6919-1 and adjoining intermediate shell plate, B6903-2, using weld wire representative of that used in the original fabrication.

Chemical Analysis

The following data was obtained from Westinghouse Analysis.

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.13	1.06	0.016	0.009	0.27	0.19	0.50	0.14	0.009	0.018

N	Cr	V	Sn
0.005	0.063	0.003	0.005

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
-100	5	15	1
-100	14	25	11
-100	18	20	11
- 40	53	43	43
- 40	60	52	44
- 40	75	50	55
+ 10	79	65	54
+ 10	86	73	63
+ 10	80	65	58
+ 72	117	100	82
+ 72	123	100	80
+ 72	113	100	79
+150	151	100	90
+150	144	100	89
+150	118	100	81
+210	138	100	88
+210	159	100	85
+210	151	100	85

Heat Treatment

1150°F ± 25°F, 16 hours. Furnace cooled.

Dropweight Tests

The nil-ductility transition temperature (NDTT) was determined for the surveillance weld metal to be -60°F by drop weight tests (ASTM E-208) performed by Combustion Engineering.

TABLE 11

Joseph M. Farley Unit 1
Surveillance Capsule Materials Data

Component: Surveillance Weld-Heat-Affected Zone (HAZ) Material were obtained from the weld-heat-affected zone of lower shell plate, B6919-1.

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
-150	15	18	7
-150	11	18	6
-150	58	45	29
-100	103	55	54
-100	33	32	19
-100	67	45	40
- 75	101	65	62
- 75	110	65	57
- 20	122	80	72
- 20	120	80	71
- 20	84	65	52
+ 50	141	100	83
+ 50	142	100	85
+ 75	95	100	74
+210	132	100	85
+210	170	100	83
+210	163	100	85

Dropweight Tests

The nil-ductility transition temperature (NDTT) was determined for the surveillance weld-heat-affected zone material to be -10°F by drop weight tests (ASTM E-208) performed by Combustion Engineering.

The initial RT_{NDT} values for the beltline region plates are calculated based on the information given in the Combustion Engineering Material Certification Reports using the methodology presented in the Branch Technical Position MTEB 5-2 contained in the Standard Review Plan. The initial RT_{NDT} values for the beltline region welds are generic mean values given in 10 CFR 50.61.

The upper shelf energy (USE) values for the beltline region plates are calculated based on the information given in the Combustion Engineering Material Certification Reports using the methodology presented in the Branch Technical Position MTEB 5-2 contained in the Standard Review Plan. The USE values for the weld metal were not determined by the fabricator.

The beltline region welds only had fabrication Charpy tests performed at 10°F, so initial USE values could not be determined. However, the surveillance weld, which is representative of the intermediate shell longitudinal welds, had an unirradiated USE of 149 ft-lb. Evaluation according to Regulatory Guide 1.99, Revision 2, of the intermediate shell longitudinal welds assuming the initial USE of 149 ft-lb results in the 32 EFPY USE prediction of 98 ft-lb.

The initial RT_{NDT} and USE values are presented in Table 12.

TABLE 12
INITIAL RT_{NDT} AND UPPER SHELF ENERGY VALUES
FOR J. M. FARLEY UNIT 1

MATERIAL DESCRIPTION	INITIAL RT_{NDT} °F	USE (Ft-lbs)
Inter Shell, B6903-2	0	152 (99)
Inter Shell, B6903-3	10	134.5 (87)
Lower Shell, B6919-1	15	132 (86)
Lower Shell, B6919-2	20	133 (86)
Inter Shell Long Welds	-56 (a)	(b)
Lower Shell Long Welds	-56 (a)	(b)
Inter/Lower Circ Weld	-56 (a)	(b)
Surveillance Plate	(c)	140 (90.7)
Surveillance Weld	(c)	149

Notes:

Numbers in () are for transverse data - estimated per MTEB 5-2.
(a) Calculated based on 10 CFR 50.61 methodology.
(b) Upper Shelf energy values are not available because unirradiated Charpy V-notch impact tests were not performed.
(c) Initial RT_{NDT} not determined for surveillance material.

4. NRC Request

Describe how the embrittlement effects of operating at an irradiation temperature (cold leg or recirculation suction temperature) below 525°F were considered. Describe consideration given to determining the effect of lower irradiation temperature on the reference temperature and on the Charpy upper shelf energy.

SNC Response

The requirements of Technical Specification 3/4.1.1.4, "Minimum Temperature for Criticality," prohibits plant criticality below 541°F. A review of plant operating records indicates that RCS average temperature has never dropped below 525°F while the core was critical. Therefore, the concern with increased embrittlement effects due to operation below 525°F is not applicable to Farley Nuclear Plant, Unit 1.

5. NRC Request

Describe how surveillance results on the predicted amount of embrittlement were considered.

SNC Response

As stated in Alabama Power Company's response to NRC Generic Letter 88-11 for the Farley Unit 1 reactor vessel dated November 23, 1988, the pressure-temperature limits developed for J. M. Farley Unit 1 were based upon the methodology of the Proposed Regulatory Guide 1.99, Revision 2. This Regulatory Guide was made effective May, 1988 and includes the same information as the proposed rule. The current Farley Unit 1 heatup and cooldown curves (16 EFPY) are applicable up to 18 EFPY. These results were based on the limiting material in the beltline region, lower shell plate B6919-2 using surveillance capsule data.

The RT_{PTS} values calculated for 32 EFPY are within the screening criteria of 10 CFR 50.61 as indicated in Table 13. These values were calculated using the data presented in Tables 2 - 8 and Table 12. The nickel content for the welds were not available from the material certifications, therefore the nickel values of 0.20 and 0.21 were used as presented in the FSAR for the welds. The copper values used in calculating the RT_{PTS} values given in Table 13 are those given in the material certifications.

TABLE 13
J. M. FARLEY UNIT 1 RT_{PTS} VALUES FOR 32 EFPY

MATERIAL DESCRIPTION	RT_{PTS} °F
Inter Shell, B6903-2	156
Inter Shell, B6903-3	154
Lower Shell, B6919-1	180 (168)
Lower Shell, B6919-2	186
Inter Shell Long Welds	153
Lower Shell Long Welds	108
Inter/Lower Circ Weld	172

()Indicates RT_{PTS} value based on surveillance capsule data.

6. NRC Request

If a measured increase in reference temperature exceeds the mean-plus-two standard deviations predicted by Regulatory Guide 1.99, Revision 2, or if a measured decrease in Charpy upper shelf energy exceeds the value predicted using the guidance in Paragraph C.1.2 in Regulatory Guide 1.99, Revision 2, report the information and describe the effect of the surveillance results on the adjusted reference temperature and Charpy upper shelf energy for each beltline material as predicted for December 16, 1991, and for the end of its current license.

SNC Response

The measured increase in reference temperature does not exceed the mean-plus-two standard deviations predicted by the Regulatory Guide 1.99, Revision 2, for any of the surveillance capsule materials as indicated in Table 14.

TABLE 14
J. M. FARLEY UNIT 1 MEASURED INCREASE IN REFERENCE TEMPERATURE VERSUS REGULATORY GUIDE 1.99, REVISION 2, PREDICTIONS

		ΔRT_{NDT} (°F)	
MATERIAL DESCRIPTION	SURVEILLANCE CAPSULE	MEASURED	R.G. 1.99, REV 2 PREDICTION + 2σ
Plate, B6919-1 (Longitudinal)	Y	85	115
	U	105	144
	X	135	158
Plate, B6919-1 (Transverse)	Y	55	115
	U	90	144
	X	105	158
Weld Metal	Y	80	121
	U	80	163
	X	100	155

The measured decrease in Charpy upper shelf energy does not exceed the value predicted using methodology specified in Regulatory Guide 1.99, Revision 2, for any of the surveillance capsule materials as indicated in Table 15.

TABLE 15
J. M. FARLEY UNIT 1 MEASURED DECREASE IN CHARPY UPPER SHELF ENERGY VERSUS REGULATORY GUIDE 1.99, REVISION 2, PREDICTIONS

		DECREASE IN UPPER SHELF ENERGY (%)	
MATERIAL DESCRIPTION	SURVEILLANCE CAPSULE	MEASURED	R.G. 1.99, REV 2 PREDICTION
Plate, B6919-1 (Longitudinal)	Y	9	20
	U	21	26
	X	19	29
Plate, B6919-1 (Transverse)	Y	0	20
	U	9	26
	X	11	29
Weld Metal	Y	13	24
	U	28	31
	X	23	35

ATTACHMENT 2

JOSEPH M. FARLEY UNIT 2

RESPONSE TO

GENERIC LETTER 92-01

1. NRC Request

Addressees who do not have a surveillance program meeting ASTM E 185-73, -79, or -82 and who do not have an integrated surveillance program approved by the NRC, are requested to describe actions taken or to be taken to ensure compliance with Appendix H to 10 CFR Part 50.

SNC Response

As stated in NUREG-0117, Supplement 5, "Safety Evaluation Report Related to the Operation of Joseph M. Farley Nuclear Plant Unit 2," dated March 1981, all requirements of 10 CFR Part 50, Appendix H, are met with the exception of Paragraph II.B. Paragraph II.B requires the beltline region of the reactor vessel to be monitored by a surveillance program complying with ASTM Standard E-185-73. The weld material included in the Farley Unit 2 surveillance program is not the most limiting weld in the reactor vessel beltline region. Alabama Power Company provided sufficient justification for this exemption and the NRC subsequently granted this exemption. The reasons stated for granting this exemption are: 1) the surveillance program includes the beltline material predicted to be most limiting (base plate B7212-1), and 2) conservative analysis methods contained in Regulatory Guide 1.99 are available to determine the radiation characteristics of the limiting beltline weld.

2. NRC Request

Addressees of plants for which the Charpy upper shelf energy is predicted to be less than 50 foot-pounds at the end of their licenses using the guidance in Paragraphs C.1.2 or C.2.2 in Regulatory Guide 1.99, Revision 2, are requested to provide to the NRC the Charpy upper shelf energy predicted for December 16, 1991, and for the end of their current license for the limiting beltline weld and the plate or forging and are requested to describe the actions taken pursuant to Paragraphs IV.A.1 or V.C of Appendix G to 10 CFR Part 50.

SNC Response

Table 1 contains the 32 EFPY Charpy upper shelf energy for Farley Unit 2 beltline materials. The calculated 32 EFPY Charpy upper shelf energy for all the beltline region plates are predicted to be above the 50 foot-pound criteria.

TABLE 1
J. M. FARLEY UNIT 2
CALCULATED 32 EFPY UPPER SHELF ENERGY

MATERIAL DESCRIPTION	EOL USE (Ft-Lbs)
Inter. Shell, B7203-1	71.6
Inter. Shell, B7212-1	64.8
Lower Shell, B7210-1	75.2
Lower Shell, B7210-2	71.3
Inter. Shell Long. Welds	(a)
Lower Shell Long. Welds	(a)
Inter./Lower Circ. Weld	(a)

(a) No estimate since upper shelf energy values are not available because unirradiated Charpy V-notch impact tests were not performed.

3. NRC Request

Addressees whose reactor vessels were constructed to an ASME Code earlier than the Summer 1972 Addenda of the 1971 Edition are requested to describe the consideration given to the following material properties in their evaluations performed pursuant to 10 CFR 50.61 and Paragraph III.A of 10 CFR Part 50, Appendix G:

(1) the results from all Charpy and drop weight tests for all unirradiated beltline materials, the unirradiated reference temperature for each beltline material, and the method of determining the unirradiated reference temperature from the Charpy and drop weight test;

(2) the heat treatment received by all beltline and surveillance materials;

(3) the heat number for each beltline plate or forging and the heat number of wire and flux lot number used to fabricate each beltline weld;

(4) the heat number for each surveillance plate or forging and the heat number of wire and flux lot number used to fabricate the surveillance weld;

(5) the chemical composition, in particular the weight in percent of copper, nickel, phosphorous, and sulfur for each beltline and surveillance material; and

(6) the heat number of the wire used for determining the weld metal chemical composition if different than Item (3) above.

SNC Response

The J. M. Farley Unit 2 reactor vessel was constructed to the 1970 Summer Addenda to Section III of the ASME Code. Thus, the J. M. Farley Unit 2 nuclear power plant was constructed to an ASME Code earlier than the Summer 1972 Addenda of the 1971 Edition. Tables 2 through 13 document the unirradiated data (Charpy and drop weight test results, reference temperature, upper shelf energy), heat treatment, heat numbers, weld flux lot number, and chemical composition for all beltline region and surveillance materials. These values were developed using the current reactor pressure vessel material test requirements and acceptance standards at the time of fabrication.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on September 23, 1969.

Component: Intermediate Shell Plate, B7203-1 Heat No.: C6309-2

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.20	1.31	0.010	0 013	0.19	0.60	0.55	0.14	0.020	0.025

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	11	0	9
- 40	23	5	18
- 40	21	5	14
+ 10	70	30	51
+ 10	76	35	53
+ 10	66	30	46
+ 40	81	40	56
+ 40	77	40	53
+ 40	89	50	61
+110	120	90	77
+110	128	90	82
+110	120	90	78
+160	142	100	86
+160	143	100	84
+160	136	100	83

Temp. °F	Drop Weights	NDT
- 40	1-F	
- 30	2-NF	
- 20	1-NF	-40°F
0	1-NF	

Heat Treatment

1600°F ± 25°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on May 20, 1970.

Component: Intermediate Shell Plate, B7212-1 Heat No.: C7466-1

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.21	1.30	0.018	0.016	0.24	0.60	0.49	0.20	0.040	0.027

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	13	0	9
- 40	14	0	9
- 40	22	5	16
+ 10	65	30	43
+ 10	76	40	53
+ 10	49	25	37
+ 40	70	40	49
+ 40	80	50	55
+ 40	89	60	63
+110	110	80	78
+110	114	80	77
+110	118	80	80
+160	133	100	83
+160	130	100	83
+160	139	100	84

Temp. °F	Drop Weights	NDT
- 40	1-F	
- 30	1-F	
- 20	2-NF	-30°F
0	1-NF	

Heat Treatment

1600°F ± 25°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on August 1, 1972.

Component: Lower Shell Plate, B7210-1 Heat No.: C6888-2

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.24	1.28	0.010	0.014	0.20	0.56	0.56	0.13	0.020	0.012

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	9	0	7
- 40	6	0	6
+ 10	28	15	16
+ 10	33	15	20
+ 10	31	15	19
+ 40	49	20	32
+ 40	36	15	25
+ 40	62	25	43
+100	101	70	72
+100	97	70	69
+100	84	60	61
+160	134	100	83
+160	125	99	82
+160	124	95	79

Temp. °F	Drop Weights	NDT
- 40	1-F	
- 30	2-NF	
- 20	1-NF	-40°F
- 10	1-NF	
0	1-NF	

Heat Treatment

1600°F ± 25°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on April 30, 1970.

Component: Lower Shell Plate, B7210-2 Heat No.: C6293-1

MILL Chemical Analysis

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.19	1.30	0.015	0.015	0.18	0.57	0.59	0.14	0.026	0.021

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 40	13	0	10
- 40	11	0	9
+ 10	67	30	45
+ 10	78	35	54
+ 10	69	30	47
+ 40	85	35	57
+ 40	100	45	66
+ 40	95	45	63
+100	142	99	78
+100	127	90	76
+100	119	80	74
+160	141	100	82
+160	146	100	86
+160	147	100	88

Temp. °F	Drop Weights	NDT
- 30	1-F	
- 20	2-NF	
- 10	1-NF	-30°F
0	1-NF	

Heat Treatment

1600°F ± 25°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours.
1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

TABLE 6

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on February 13, 1973.

Component: Intermediate to Lower Shell Circle Seam, 11-923

Weld Wire: Type B4, Heat No. 5P5622 Flux: Linde 0091, Lot No. 1122

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cu	V
0.17	1.29	0.016	0.008	0.19	0.57	0.13	0.009

Charpy Impact Tests

Temp. °F	Ft-Lbs	Mils Lat. Exp.
+ 10	100	62
+ 10	99	60
+ 10	108	63
+ 20	100	64
+ 20	105	66
+ 20	98	63

Temp. °F	Drop Weights	NDT
- 40	1-F	
- 30	2-NF	-40°F
- 20	1-NF	

Heat Treatment

1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on September 15, 1971.

Component: Intermediate Shell long. Seams, 19-923A

Weld Wire: Type E8018C3, Heat No. HODA Mix: 8066

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cu	Ni	V
0.09	1.00	0.009	0.010	0.38	0.25	0.02	0.96	0.010

Charpy Impact Tests

Temp. °F	ft-Lbs
+ 10	130
+ 10	135
+ 10	128

Heat Treatment

1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering, Inc. on April 26, 1973.

Component: Intermediate Shell Long. Seam, 19-923B

Weld Wire: Type E8018C3, Heat No. BOLA Flux: Not Available

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cu	Ni	V
0.081	1.02	0.010	0.016	0.41	0.24	0.02	0.93	0.005

Charpy Impact Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
0	82	50	58
0	101	60	70
0	108	70	75
+ 10	106	70	66
+ 10	108	70	72
+ 10	105	70	71

Temp. °F	Drop Weights	NDT
- 60	1-F	
- 50	2-NF	
- 40	1-NF	-60°F
- 20	1-NF	

Heat Treatment

1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

Joseph M. Farley Unit 2
Materials Certification Information

The following information was taken from the Materials Certification Report prepared by Combustion Engineering Inc. on August 17, 1972.

Component: Lower Shell Long. Seam, 20-923A&B

Weld Wire: Type B4, Heat No. 83640 Flux: Linde 0091, Lot No. 3490

MILL Chemical Analysis

C	Mn	P	S	Si	Mo	Cr	V
0.16	1.22	0.006	0.011	0.19	0.57	0.05	0.006

Charpy Impact Tests

Temp. °F	Ft-Lbs	Mils Lat. Exp.
- 10	119	85
- 10	118	74
- 10	110	78
+ 10	126	86
+ 10	124	85
+ 10	129	87

Temp. °F	Drop Weights	NDT
- 70	1-F	
- 60	2-NF	
- 40	1-NF	-70°F
- 20	1-NF	

Heat Treatment

1150°F ± 25°F, 40 hours. Furnace cooled to 600°F.

TABLE 10

Joseph M. Farley Unit 2
Surveillance Capsule Materials Data

The following information was taken from WCAP-8956, "Alabama Power Company Joseph M. Farley Nuclear Plant Unit No. 2 Reactor Vessel Radiation Surveillance Program," August 1977.

Component: Surveillance Material SA533 Grade B Class 1 plate used for the intermediate shell plate, B7212-1.

Chemical Analysis

The following data was obtained from Combustion Engineering Analysis, unless otherwise noted.

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
0.21	1.30	0.018	0.016	0.24	0.60	0.49	0.20	0.040	0.027

N*	Cr*	V*	Sn*
0.006	0.15	0.003	0.011

* Westinghouse Analysis.

Charpy Impact and Fracture Tests
Intermediate Shell Plate, B7212-1 (Longitudinal)

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 60	12	8	9
- 50	15	12	11
- 25	19	22	16
- 25	34	18	26
- 10	47	25	35
0	50	30	40
+ 2[illegible]	63	40	49
+ 50	72	60	60
+ 60	67	48	53
+ 75	103	63	71
+100	110.5	85	80
+125	123	100	84
+150	132	100	91
+210	134	100	87
+210	130	100	90
+210	132	100	89

Charpy Impact and Fracture Tests
Intermediate Shell Plate, B7212-1 (Transverse)

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
- 50	18.5	12	11
- 50	15.5	14	11
- 50	19	12	11
0	35	27	27
0	34.5	25	27
0	30	25	27
+ 30	43	32	35
+ 30	48	35	36
+ 30	52	43	39
+100	76.5	73	55
+100	74	73	56
+100	70	69	54
+150	95	100	67
+150	98	100	68
+150	106	100	76
+210	89	100	68
+210	94	100	70
+210	88	100	69

Heat Treatment
Intermediate Shell Plate, B7212-1

1550°F/1650°F, 4 hours. Water quenched.
1225°F ± 25°F, 4 hours. Air cooled.
1150°F ± 25°F, 18 hours. Furnace cooled to 600°F.

Dropweight Tests
Intermediate Shell Plate, B7212-1

The nil-ductility transition temperature (NDTT) was determined for plate B7212-1 to be -30°F by drop weight tests (ASTM E-208) performed by Combustion Engineering.

Joseph M. Farley Unit 2
Surveillance Capsule Materials Data

Component: Surveillance Weld Material made from sections of intermediate shell plate, B7212-1 and adjoining intermediate shell plate, B7203-1, using weld wire representative of that used in the original fabrication.

Chemical Analysis

The following data was obtained from Combustion Engineering Analysis.

C	Mn	P	S	Si	Ni	Mo	Cu	Al	Co
<0.086	0.95	0.004	0.014	0.34	0.90	0.23	0.03	0.003	0.010

N	Cr	V	Sn
0.007	<0.01	0.006	0.002

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
-100	8	12	7
- 50	16	30	15
- 25	42	40	35
- 10	50	43	44
+ 10	109	80	73
+ 25	68	72	60
+ 40	124	85	80
+ 50	133	94	89
+ 75	144	100	92
+100	132	100	91
+150	131	100	92
+150	150	100	91
+175	154.5	100	90
+210	154	100	91
+210	153	100	93
+210	137	100	92

Heat Treatment

1150°F ± 25°F, 13 hours. Furnace cooled.

Dropweight Tests

The nil-ductility transition temperature (NDTT) was determined for the surveillance weld metal to be -70°F by drop weight tests (ASTM E-208) performed by Combustion Engineering.

Joseph M. Farley Unit 2
Surveillance Capsule Materials Data

Component: Surveillance Weld-Heat-Affected Zone (HAZ) Material were obtained from the weld-heat-affected zone of intermediate shell plate, B7212-1.

Charpy Impact and Fracture Tests

Temp. °F	Ft-Lbs	% Shear	Mils Lat. Exp.
-200	11	8	5
-150	159	100	95
-100	98	45	57
-100	40	42	33
- 50	98	60	60
- 50	71	34	46
+ 20	44	82	73
25	113.5	83	79
50	136	100	91
+ 75	123	100	87
+100	191	100	81
+150	159	100	95
+210	151	100	91
+210	86	93	73
+210	189	100	87

Dropweight Tests

The nil-ductility transition temperature (NDTT) was determined for the surveillance weld-heat-affected zone material to be -80°F by drop weight tests (ASTM E-208) performed by Combustion Engineering.

The initial RT_{NDT} values for the beltline region plates are calculated based on the information provided in Nuclear Safety Task Sheet 17276 (transverse data). The initial RT_{NDT} values for the beltline region welds are calculated based on the information given in the Combustion Engineering Material Certification Reports using the methodology of the Branch Technical Position MTEB 5-2.

The upper shelf energy (USE) values for the beltline region plates were calculated using the data provided in Nuclear Safety Task Sheet 17267. Data was not available to calculate upper shelf energy values for the welds.

The beltline region welds only had fabrication Charpy tests performed at 10°F, so initial USE values could not be determined. However, the surveillance weld, which is representative of the intermediate shell longitudinal weld seam, 19-923B, had an unirradiated USE of 148 ft-lb. Evaluation according to Regulatory Guide 1.99, Revision 2, of the intermediate shell longitudinal weld seam 19-923B assuming the initial USE of 148 ft-lb results in the 32 EFPY USE prediction of 121 ft-lb.

The initial RT_{NDT} and USE values are presented in Table 13.

TABLE 13
INITIAL RT_{NDT} AND UPPER SHELF ENERGY VALUES
FOR J. M. FARLEY UNIT 2

MATERIAL DESCRIPTION	INITIAL RT_{NDT} °F	USE (Ft-Lbs)
Inter Shell, B7203-1	15	99.5
Inter Shell, B7212-1	-10	99.7
Lower Shell, B7210-1	18	103
Lower Shell, B7210-2	0	99
Long Weld Seam, 19-923A	-56 (a)	(b)
Long Weld Seam, 19-923B	-60	(b)
Long Weld Seams, 20-923A&B	-70	(b)
Inter/Lower Circ Weld	-40	(b)
Surveillance Plate	(c)	100
Surveillance Weld	(c)	148

Notes:

(a) Estimated per 10 CFR 50.61.
(b) Upper Shelf energy values are not available because unirradiated Charpy V-notch impact tests were not performed.
(c) Initial RT_{NDT} not determined for surveillance material.

4. NRC Request

Describe how the embrittlement effects of operating at an irradiation temperature (cold leg or recirculation suction temperature) below 525°F were considered. Describe consideration given to determining the effect of lower irradiation temperature on the reference temperature and on the Charpy upper shelf energy.

SNC Response

The requirements of Technical Specification 3/4.1.1.4, "Minimum Temperature for Criticality," prohibits plant criticality below 541°F. A review of plant operating records indicates that RCS average temperature has never dropped below 525°F while the core was critical. Therefore, the concern with increased embrittlement effects due to operation below 525°F is not applicable to Farley Nuclear Plant, Unit 2.

5. NRC Request

Describe how surveillance results on the predicted amount of embrittlement were considered.

SNC Response

The pressure-temperature limits developed for J. M. Farley Unit 2 as part of the Surveillance Capsule X Testing Program were based upon the methodology of Regulatory Guide 1.99, Revision 2. These curves were based on the limiting material in the beltline region, intermediate shell plate B7212-1 using surveillance capsule data. The RT_{PTS} values calculated for 32 EFPY are within the screening criteria of 10 CFR 50.61 as indicated in Table 14. These values were calculated using the data presented in Tables 2 - 9 and Table 13. The nickel content for the lower shell longitudinal welds and the intermediate to lower shell circumferential weld were not available from the material certifications, therefore the nickel value of 0.20 was used as presented in the FSAR for these welds.

TABLE 14
J. M. FARLEY UNIT 2 RT_{PTS} VALUES FOR 32 EFPY

MATERIAL DESCRIPTION	RT_{PTS} °F
Inter Shell, B7203-1	184
Inter Shell, B7212-1	224 (217)
Lower Shell, B7210-1	173
Lower Shell, B7210-2	177
Long Weld, 19-923A	39
Long Weld, 19-923B	25
Long Weld, 20-923A&B	38
Inter/Lower Circ Weld	118

()Indicates RT_{PTS} value based on surveillance capsule data.

6. NRC Request

If a measured increase in reference temperature exceeds the mean-plus-two standard deviations predicted by Regulatory Guide 1.99, Revision 2, or if a measured decrease in Charpy upper shelf energy exceeds the value predicted using the guidance in Paragraph C.1.2 in Regulatory Guide 1.99, Revision 2, report the information and describe the effect of the surveillance results on the adjusted reference temperature and Charpy upper shelf energy for each beltline material as predicted for December 16, 1991, and for the end of its current license.

SNC Response

The measured increase in reference temperature does not exceed the mean-plus-two standard deviations predicted by the Regulatory Guide 1.99, Revision 2, for any of the surveillance capsule materials as indicated in Table 15.

TABLE 15
J. M. FARLEY UNIT 2 MEASURED INCREASE IN REFERENCE TEMPERATURE VERSUS REGULATORY GUIDE 1.99, REVISION 2, PREDICTIONS

MATERIAL DESCRIPTION	SURVEILLANCE CAPSULE	ΔRT_{NDT} (°F) MEASURED	ΔRT_{NDT} (°F) R.G. 1.99, REV 2 PREDICTION + 2σ
Plate, B7212-1 (Longitudinal)	U	103	156
	W	165	198
	X	180	228
Plate, B7212-1 (Transverse)	U	133	156
	W	165	198
	X	19[illegible]	228
Weld Metal	U	10	90
	W	10	101
	X	10	109

The measured decrease in Charpy upper shelf energy does not exceed the value predicted using methodology specifies in Regulatory Guide 1.99, Revision 2, for the surveillance capsule materials tested in the Capsule W and X analyses as indicated in Table 16. The measured decrease in Charpy USE for plate B7212-1 was greater than the Regulatory Guide 1.99, Revision 2, prediction in the Capsule U analysis. This decrease was less than 3 ft-lb more than the predictions and is most likely due to the uncertainty in the analysis methods. The predicted 32 EFPY upper shelf energy values are predicted to be above the 50 ft-lb criteria as shown in Table 1.

TABLE 16
J. M. FARLEY UNIT 2 MEASURED DECREASE IN CHARPY UPPER SHELF ENERGY VERSUS REGULATORY GUIDE 1.99, REVISION 2, PREDICTIONS

MATERIAL DESCRIPTION	SURVEILLANCE CAPSULE	DECREASE IN UPPER SHELF ENERGY (%) MEASURED	R.G. 1.99, REV 2 PREDICTION
Plate, B7212-1 (Longitudinal)	U	27.7	25
	W	21.5	32
	X	27.7	36
Plate, B7212-1 (Transverse)	U	27.0	25
	W	20.0	32
	X	27.0	36
Weld Metal	U	8.3	16
	W	0	21
	X	0	24