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Docket No. 50-423
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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Millstone Nuclear Power Station, Unit No. 3
Start-Up Test Report for Cycle 6

Millstone Unit No. 3 entered Mode 1 on June 6, 1995, and the Cycle 6 startup test program was completed on June 23, 1995, following its refueling outage. As required by the Millstone Unit No. 3 Technical Specifications, Section 6.9.1.1, Northeast Nuclear Energy Company hereby submits the attached Millstone Unit No. 3 Start-up Test Report.

Should you have any questions related to this submittal, please contact Mr. Jeffrey Camp of Millstone Unit 3 Technical Support, at (860) 447-1791, extension 6076.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

D. B. Miller, Jr.
Senior Vice President - Millstone

Attachment

cc: T. T. Martin, Region I Administrator
V. L. Rooney, NRC Project Manager, Millstone Unit No. 3
P. D. Swetland, Senior Resident Inspector, Millstone Unit Nos. 1, 2, and 3

IE24

Docket No. 50-423

MILLSTONE NUCLEAR POWER STATION
UNIT NO. 3
STARTUP TEST REPORT
CYCLE 6

September 1995

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1. SUMMARY

Low Power Physics Testing and Power Ascension Testing for Millstone 3, Cycle 6 identified no unusual situations or anomalies. All parameters were determined to be within their acceptance criteria. All Technical Specification limits were met.

2. INTRODUCTION

The Millstone 3, Cycle 6 fuel reload was completed on May 19, 1995. The attached core loading pattern (Figure 1) shows the final core configuration. Eighty-four (84) new Region 8 fuel assemblies were inserted into the core. Major changes from the Millstone 3, Cycle 5 core design are:

* Addition of 2 thimble plugs and 2 new unactivated secondary source assemblies such that all locations contain an insert. Also, the locations of the two activated secondary sources was changed.

* Decrease the number of Vantage 5H fuel assemblies from 172 to 168. Vantage 5H fuel assemblies are Region 6, 7 and 8. Region 4 fuel assemblies were loaded on the core periphery where Region 6 fuel assemblies would normally have gone. This is because there were insufficient numbers of Region 6 fuel assemblies available with rotated grids to put on the core periphery.

* 1 leaking fuel rod in a Region 7 fuel assembly was replaced with a stainless steel filler rod.

* 1 top nozzle was replaced on a fresh Region 8 fuel assembly due to a manufacturing problem identified prior to fuel loading.

Subsequent operational and testing milestones were completed as follows:

Initial Criticality	June 3, 1995
Low Power Physics Testing completed	June 6, 1995
Main Turbine On-Line	June 7, 1995
30% Power Testing completed	June 7, 1995
75% Power Testing completed	June 10, 1995
100% Power Testing completed	June 23, 1993

Cycle 6 operation is with 193 Westinghouse manufactured fuel assemblies. The Safety Analysis is provided by Westinghouse.

3. LOW POWER PHYSICS TESTING RESULTS

Low Power Physics Testing was performed at a power level of <5 x 10^{-2}% power to avoid nuclear fuel heating effects.

3.1 Critical Boron Concentrations

Critical Boron Concentration (CBC) was measured at two different Rod Control Cluster Assembly (RCCA) configurations; at All Rods Out (ARO) and with RCCA Control Banks D, C, B and A inserted.

The CBC measured with Control Bank D at 204 steps was 2178 ppm. Adjusted to All Rods Out, the CBC was 2181 ppm.

Therefore,

Measured CBC at BOL-HZP-ARO = 2181 ppm
Predicted CBC at BOL-HZP-ARO = 2193 ppm
Difference = 12 ppm

The Acceptance Criteria is ± 75 ppm.
Acceptance Criteria met? Yes

The CBC measured with Control Banks D, C, B, inserted and A at 28 steps was 1644 ppm. Adjusted to All Rods In (ARI), the CBC was 1648 ppm.

The predicted CBC for Control Banks A, B, C and D inserted is 1658 ppm, therefore the difference is;

Predicted CBC at BOL-HZP-ARI = 1658 ppm
Measured CBC at BOL-HZP-ARI = 1648 ppm
Difference = 10 ppm

The Acceptance Criteria is ± 75 ppm
Acceptance Criteria met? Yes

Measured CBC at BOL-HZP-ARO = 2181 ppm
Measured CBC at BOL-HZP-ARI = 1648 ppm
Difference = 533 ppm

Predicted CBC at BOL-HZP-ARO = 2193 ppm
Predicted CBC at BOL-HZP-ARI = 1658 ppm
Difference = 535 ppm

Therefore, the difference between the predicted and measured values is:

Predicted Difference in ARO and ARI CBCs	=	535 ppm
Measured Difference in ARO and ARI CBCs	=	533 ppm
Difference	=	2 ppm

There is no acceptance criteria on this value.

3.2 Isothermal/Moderator Temperature Coefficients

The Isothermal Temperature Coefficient (ITC) was measured with all RCCA banks withdrawn (ARO). The Moderator Temperature Coefficient (MTC) was then calculated.

ARO ITC Measurement:

The measured ITC value with Control Bank D at 204 steps, an average Reactor Coolant System (RCS) temperature of 556ºF, and an RCS Boron Concentration of 2178 ppm, was -0.0921 pcm/ºF.

Comparing the measured ITC to the predicted ITC yields:

Measured ITC at BOL, ARO	=	-0.0921 pcm/ºF
Predicted ITC at BOL, ARO	=	-0.01 pcm/ºF
Difference	=	0.0821 pcm/ºF

The Acceptance Criteria is -0.01 pcm/ºF ± 2 pcm/ºF
Acceptance Criteria met? Yes

All Rods Out MTC Determination

The MTC was calculated by subtracting the design Doppler Temperature Coefficient (-1.74 pcm/ºF) from the ARO ITC. In addition to comparing the measured MTC to the predicted value, it was required to verify that the Technical Specification MTC limit of MTC < +5 pcm/ºF at ARO, HZP was met.

Calculating the MTC yields:

-0.0921 pcm/ºF - (-1.74 pcm/ºF) = 1.6479 pcm/ºF

Comparing the measured MTC to the predicted MTC yields:

Calculated MTC at BOL, ARO	=	1.6479 pcm/ºF
Predicted MTC at BOL, ARO	=	1.72 pcm/ºF

Technical Specification Acceptance Criteria is MTC < +5 pcm/ºF
Acceptance Criteria met? Yes

3.3 Control Rod Reactivity Worth Measurements

Reactivity worth measurements were performed individually on Control Banks D, C, B, and A. The results of the measurements were:

Individual Bank Worth Measurements (by dilution)

Bank	Measured Worths (pcm)	Predicted Worths (pcm)	Delta (M-P)	% Difference ((M-P)/P)
Control D	472	483	-11	-2.3
Control C	1121	1108	13	1.2
Control B	712	740	-28	-3.8
Control A	1059	1039	20	1.9
Total	3364	3370	6	0.18

The Acceptance Criteria for the Total Worth of the Control Banks inserted is ±10 % of the predicted total worth. The Acceptance Criteria for any individual Control Bank is the greater of either ±100 pcm or ±15% of the predicted Bank worth.

Acceptance Criteria met? Yes

Measurement of Control Rod Reactivity Worth also verified the Technical Specification Surveillance requirements for SHUTDOWN MARGIN, which require that at least 1.3% reactivity (1300 pcm) exists below the zero power rod insertion limit.

4. POWER ASCENSION TESTING RESULTS

4.1 Power Peaking and Tilt Measurements

Flux Maps were performed to determine incore power distribution and tilt.

The measurements of these parameters, including uncertainty, were:

HEAT FLUX HOT CHANNEL FACTOR - FQ(Z)

	Above Midpoint Peak		Below Midpoint Peak		
Power Level	Measured FQ(Z)	FQ(Z) Limit	Measured FQ(Z)	FQ(Z) Limit	Max Incore Tilt
30%	1.895	6.077	1.265	6.543	1.010
60%	1.684	3.061	1.507	3.296	1.005
75%	1.567	2.470	1.599	2.660	1.004
100%	1.550	1.830	1.650	1.971	1.003

NUCLEAR ENTHALPY RISE HOT CHANNEL FACTOR - FNDH

Power Level	Measured FNDH	FNDH Limit
30%	1.50	1.86
60%	1.48	1.72
75%	1.46	1.66
100%	1.45	1.54

4.2 Boron Measurements

At 100% power, 1599 MWD/MTU, Control Bank D at 222 steps and Equilibrium Xenon, the measured RCS Boron Concentration, C_B, was 1632 ppm.

Measured C_B, adjusted to ARO = 1632 ppm
Predicted C_B at 100% power, ARO,
1599 MWD/MTU, Equilibrium Xenon = 1633 ppm
Difference = -1 ppm

Subsequent RCS Boron measurements made at 100% power, 2530 MWD/MTU, Control Bank D at 223 steps and equilibrium xenon, yielded the following results:

Measured C_B = 1673 ppm
Predicted C_B at 100% power, ARO,
2530 MWD/MTU, Equilibrium Xenon = 1660 ppm
Difference = -13 ppm

The Acceptance Criteria is ± 166 ppm (± 1000 pcm)
Acceptance Criteria met? Yes

4.3 Doppler Only Power Coefficient

A Doppler Only Power Coefficient verification factor (PC_m) was calculated at 100% power and compared to the predicted Doppler Only Power Coefficient verification factor (PC_p). Measurements were taken at an average power of 99.0%, an average RCS temperature of 591.4°F, and an RCS Boron Concentration of 1586 ppm. (Note: average RCS temperature is not loop average but core average.)

Average Calculated value, $|PC_m|$ = -1.08 °F/%
Predicted value, $|PC_p|$ = 0.85 °F/%
Difference = 0.23 °F/%

The Acceptance Criteria is an absolute difference of <0.5 °F/% between PC_m and PC_p.

Acceptance Criteria met? Yes

4.4 Reactor Coolant System Flow

RCS flow was measured at 100% power as verification of acceptable flow. Measured RCS flow at 100% power was 391,358 GPM.

The Acceptance Criteria is that RCS flow, adjusted for venturi fouling, must be greater than 371,920 GPM.

Acceptance Criteria met? Yes

4.5 Power Distribution

Power Distribution maps are shown for 30%, 60%, 75% and 100% power conditions in Figures 2, 3, 4 and 5. The agreement between the measurements and the predictions is good.

The Acceptance Criteria is that all locations are within ±10% of the predicted value.

Acceptance Criteria met? Yes

5. REFERENCES

5.1 In-Service Test 3-95 001, Cycle 6 Low Power Physics Tests

5.2 In-Service Test 3-95-019, Cycle 6 Power Ascension Tests

5.3 Westinghouse Nuclear Design Report - Cycle 6 (WCAP 14335)

5.4 ANSI/ANS - 19.6.1 (1985) Reload Startup Physics Tests For Pressurized Water Reactors

Figure 1

Core Loading Pattern

Millstone Unit 3 - Cycle 6

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	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					4B D70	4B D69	7 G55	7 G65	7 G48	4B D73	4B D65				
2			4B D79	7 G18	8 H02	8 H32	8 H10	8 H18	8 H12	8 H51	8 H04	7 G06	4B D84		
3		4B D75	7 G25	8 H20	8 H54	7 G14	7 G31	8 H69	7 G42	7 G13	8 H71	8 H21	7 G24	4B D80	
4		7 G09	8 H26	8 H30	7 G32	8 H81	7 G80	8 H39	7 G51	8 H63	7 G44	8 H64	8 H27	7 G07	
5	4B D78	8 H05	8 H59	7 G35	7 G57	8 H61	7 G69	7 G67	7 G75	8 H50	7 G70	7 G29	8 H53	8 H06	4B D58
6	4B D62	8 H29	7 G05	8 H68	8 H48	7 G23	8 H41	7 G17	8 H76	7 G27	8 H74	8 H66	7 G19	8 H84	4B D60
7	7 G83	8 H13	7 G43	7 G68	7 G73	8 H65	7 G47	8 H62	7 G45	8 H73	7 G72	7 G52	7 G30	8 H14	7 G74
8	7 G50	8 H17	8 H40	8 H78	7 G78	7 G01	8 H38	4A D51	8 H52	7 G02	7 G84	8 H72	8 H57	8 H28	7 G59
9	7 G64	8 H15	7 G37	7 G79	7 G49	8 H75	7 G53	8 H77	7 G56	8 H83	7 G82	7 G63	7 G38	8 H09	*7 G81
10	4B D59	8 H33	7 G08	8 H82	8 F34	7 G26	8 H46	7 G15	8 H37	7 G22	8 H47	8 H56	7 G10	8 H55	4B D68
11	4B D74	8 H07	8 H42	7 G34	7 G76	8 H70	7 G71	7 G77	7 G54	8 H60	7 G66	7 G36	8 H79	8 H01	4B D71
12		7 G04	8 H19	8 H58	7 G40	8 H43	7 G58	8 H49	7 G61	8 H36	7 G39	8 H35	8 H24	7 G20	
13		4B D72	7 G28	8 H25	8 H44	7 G12	7 G33	8 H67	7 G41	7 G11	8 H80	8 H22	7 G21	4B D61	
14			4B D83	7 G16	8 H08	8 H45	8 H16	8 H23	8 H11	8 H31	8 H03	7 G03	4B D77		
15					4B D76	4B D81	7 G46	7 G60	7 G62	4B D63	4B D64				

90°

0°

LEGEND

R ID	REGION IDENTIFIER FUEL ASSEMBLY IDENTIFICATION

* Reconstituted Assembly

Region #	Assemblies	Enrichment
4A	1	3.5
4B	24	3.8
7	84	4.4
8	84	4.6

Figure 2

Incore Power Distribution - 30%
Millstone Unit 3 - Cycle 6

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					273	363	499	536	493	351	263				
2			238	618	988	1044	1242	1264	1228	1026	1034	663	249		
3		251	712	1082	1250	1293	1239	1333	1237	1301	1240	1122	709	241	
4		663	1121	1105	1134	1317	1095	1214	1095	1285	1122	1097	1094	637	
5	271	1052	1262	1143	1156	1336	1120	1059	1089	1279	1123	1118	1224	1034	270
6	352	1051	1343	1328	1330	1346	1315	1200	1271	1296	1289	1314	1317	1052	359
7	495	1249	1263	1133	1131	1303	1111	1168	1101	1291	1116	1137	1255	1247	494
8	549	1289	1359	1251	1085	1208	1165	795	1166	1212	1087	1263	1359	1278	540
9	512	1269	1269	1121	1112	1285	1085	1156	1104	1299	1121	1125	1251	1249	505
10	365	1055	1363	1310	1307	1314	1267	1193	1281	1321	1305	1305	1304	1016	352
11	265	1014	1252	1128	1130	1299	1097	1061	1094	1288	1116	1111	1221	1012	265
12		634	1062	1099	1123	1303	1107	1226	1101	1289	1109	1082	1066	625	
13		241	691	1084	1231	1306	1234	1322	1216	1278	1218	1101	703	238	
14			243	631	1010	1026	1222	1241	1207	1016	1032	659	246		
15					256	352	489	522	480	354	271				

Legend: Measured Assembly Powers Scale: x 0.001

Figure 3

Incore Power Distribution - 60%
Millstone Unit 3 - Cycle 6

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					283	370	501	534	493	354	271				
2			249	613	942	1017	1203	1218	1194	1013	1032	680	264		
3		266	737	1092	1236	1286	1213	1297	1215	1301	1251	1152	733	251	
4		673	1141	1225	1147	1280	1096	1200	1094	1273	1150	1222	1116	647	
5	277	1035	1245	1159	1156	1307	1119	1065	1091	1256	1120	1138	1237	1043	288
6	357	1025	1304	1300	1303	1312	1306	1205	1274	1276	1275	1299	1301	1049	377
7	488	1196	1224	1118	1119	1287	1129	1211	1135	1298	1119	1140	1240	1233	509
8	544	1240	1318	1228	1078	1202	1200	934	1217	1217	1088	1250	1334	1260	556
9	513	1228	1247	1114	1110	1278	1105	1197	1126	1289	1119	1120	1235	1243	524
10	374	1034	1349	1284	1285	1291	1265	1196	1269	1294	1293	1292	1293	973	353
11	270	987	1229	1150	1138	1283	1095	1066	1096	1282	1125	1136	1220	985	270
12		642	1059	1223	1146	1279	1099	1214	1099	1282	1121	1198	1075	630	
13		253	706	1107	1238	1287	1215	1298	1197	1268	1210	1120	730	251	
14			254	645	1004	1016	1197	1207	1177	1017	1031	673	262		
15					265	366	498	527	486	371	284				

Legend: Measured Assembly Powers Scale: x 0.001

Figure 4

Incore Power Distribution - 75%
Millstone Unit 3 - Cycle 6

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					285	372	500	533	493	358	274				
2			250	617	948	1024	1201	1215	1188	1009	1025	672	263		
3		266	738	1088	1240	1279	1209	1293	1207	1277	1232	1138	731	253	
4		674	1140	1218	1150	1284	1095	1203	1091	1270	1140	1216	1113	648	
5	281	1037	1243	1153	1156	1306	1121	1071	1098	1265	1125	1138	1228	1034	286
6	361	1028	1299	1297	1300	1317	1312	1214	1283	1285	1283	1292	1286	1038	371
7	491	1197	1218	1114	1118	1296	1136	1223	1139	1304	1126	1135	1231	1220	504
8	541	1231	1305	1226	1080	1216	1215	944	1223	1223	1094	1248	1327	1248	551
9	509	1219	1231	1113	1113	1286	1115	1207	1130	1295	1122	1121	1233	1235	519
10	373	1030	1326	1282	1282	1291	1273	1204	1279	1301	1295	1294	1289	978	355
11	273	998	1227	1147	1136	1283	1099	1071	1101	1285	1127	1138	1222	990	271
12		649	1066	1221	1143	1277	1097	1213	1098	1285	1127	1204	1088	636	
13		255	710	1109	1236	1281	1204	1288	1191	1266	1217	1131	738	255	
14			256	648	1009	1014	1190	1201	1174	1012	1036	681	266		
15					268	365	496	525	486	368	285				

Legend: Measured Assembly Powers   Scale: x 0.001

Figure 5

Incore Power Distribution - 100%
Millstone Unit 3 - Cycle 6

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					287	375	499	531	492	363	277				
2			258	635	976	1032	1192	1206	1181	1013	1025	668	267		
3		269	744	1103	1236	1261	1196	1279	1196	1271	1225	1132	739	261	
4		672	1138	1216	1145	1279	1085	1196	1085	1271	1138	1213	1118	655	
5	283	1037	1236	1147	1150	1299	1122	1075	1102	1269	1130	1137	1217	1025	281
6	367	1030	1288	1288	1295	1315	1318	1224	1289	1287	1285	1290	1278	1031	368
7	496	1193	1204	1106	1116	1301	1143	1235	1146	1307	1126	1130	1223	1211	498
8	536	1217	1288	1220	1081	1224	1225	955	1231	1229	1095	1245	1320	1240	544
9	504	1204	1209	1106	1113	1289	1121	1216	1143	1305	1123	1119	1225	1224	513
10	372	1027	1301	1280	1281	1291	1274	1209	1288	1312	1299	1298	1288	1001	364
11	278	1014	1229	1146	1134	1281	1097	1073	1104	1293	1132	1143	1225	1013	278
12		659	1091	1211	1135	1267	1091	1211	1097	1293	1134	1212	1106	653	
13		261	727	1110	1221	1266	1193	1280	1188	1268	1218	1134	746	263	
14			262	652	1006	1009	1182	1194	1171	1009	1034	680	269		
15					272	366	494	524	486	368	284				

Legend: Measured Assembly Powers   Scale: x 0.001