

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.3 RCS Pressure and Temperature (P/T) Limits

LCO 3.4.3 RCS pressure and RCS temperature shall be limited during RCS heatup and cooldown, criticality, and inservice leak and hydrostatic testing in accordance with:

- a. A maximum heatup rate as specified in Figure 3.4.3-1, Figure 3.4.3-2, Figure 3.4.3-3, or Figure 3.4.3-4;
- b. A maximum cooldown rate as specified in Figure 3.4.3-5 or Figure 3.4.3-6; and
- c. A maximum temperature change of $\leq 10^{\circ}\text{F}$ in any 1 hour period during inservice leak and hydrostatic testing operations above the heatup and cooldown limit curves.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. -----NOTE----- Required Action A.2 shall be completed whenever this Condition is entered. ----- Requirements of LCO not met in MODE 1, 2, 3, or 4.	A.1 Restore parameter(s) to within limits.	30 minutes
	<u>AND</u> A.2 Determine RCS is acceptable for continued operation.	72 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3.	6 hours
	<u>AND</u> B.2 Be in MODE 5 with RCS pressure < 500 psig.	36 hours

(continued)

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL LONGITUDINAL WELD

LIMITING ART VALUES AT 34 EFPY: 1/4T, 202°F
 3/4T, 146°F

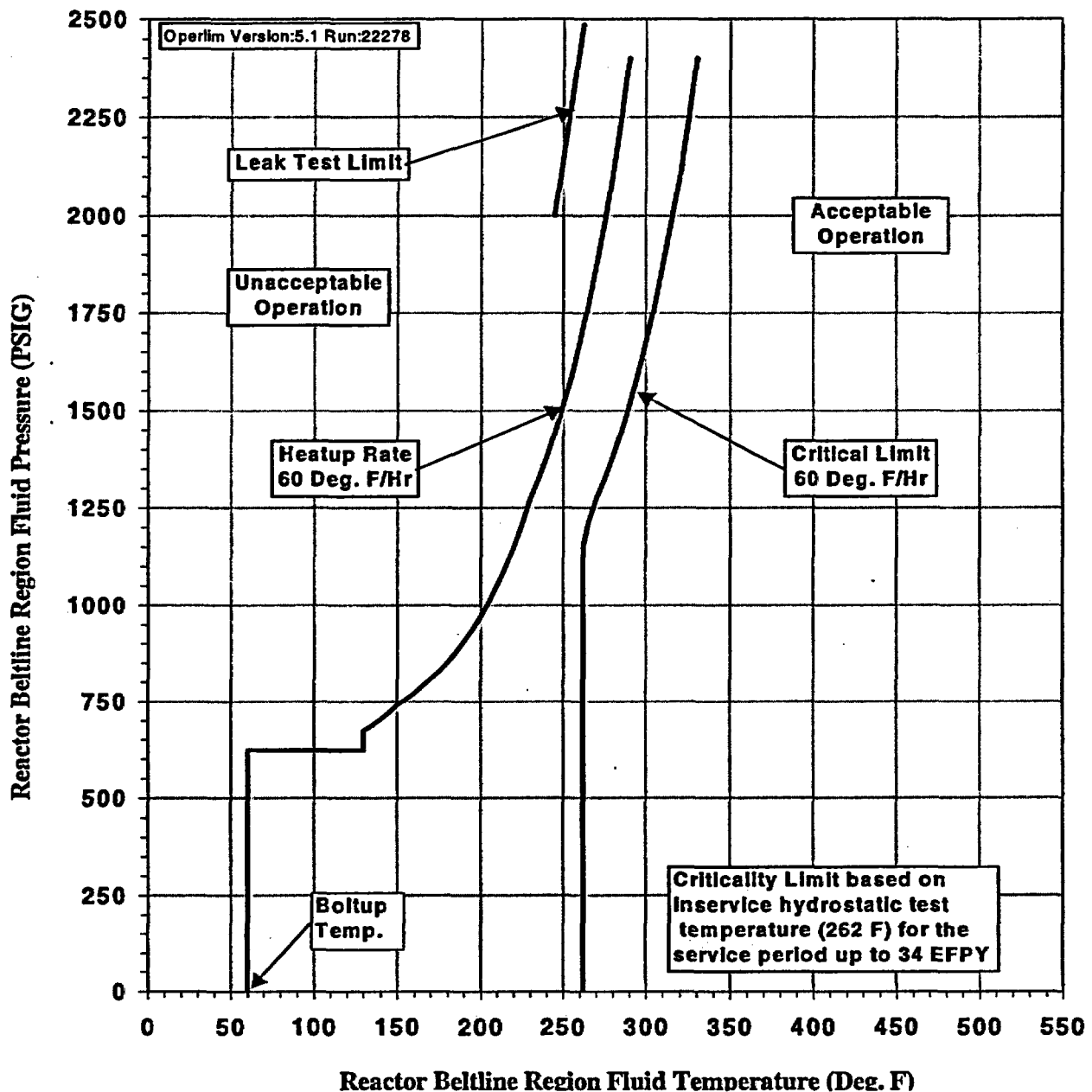


Figure 3.4.3-1 McGuire Unit 1 Reactor Coolant System Heatup Limitations (Heatup Rate of 60°F/hr) Applicable for the First 34 EFPY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL LONGITUDINAL WELD

LIMITING ART VALUES AT 34 EFPY:
1/4T, 202°F
3/4T, 146°F

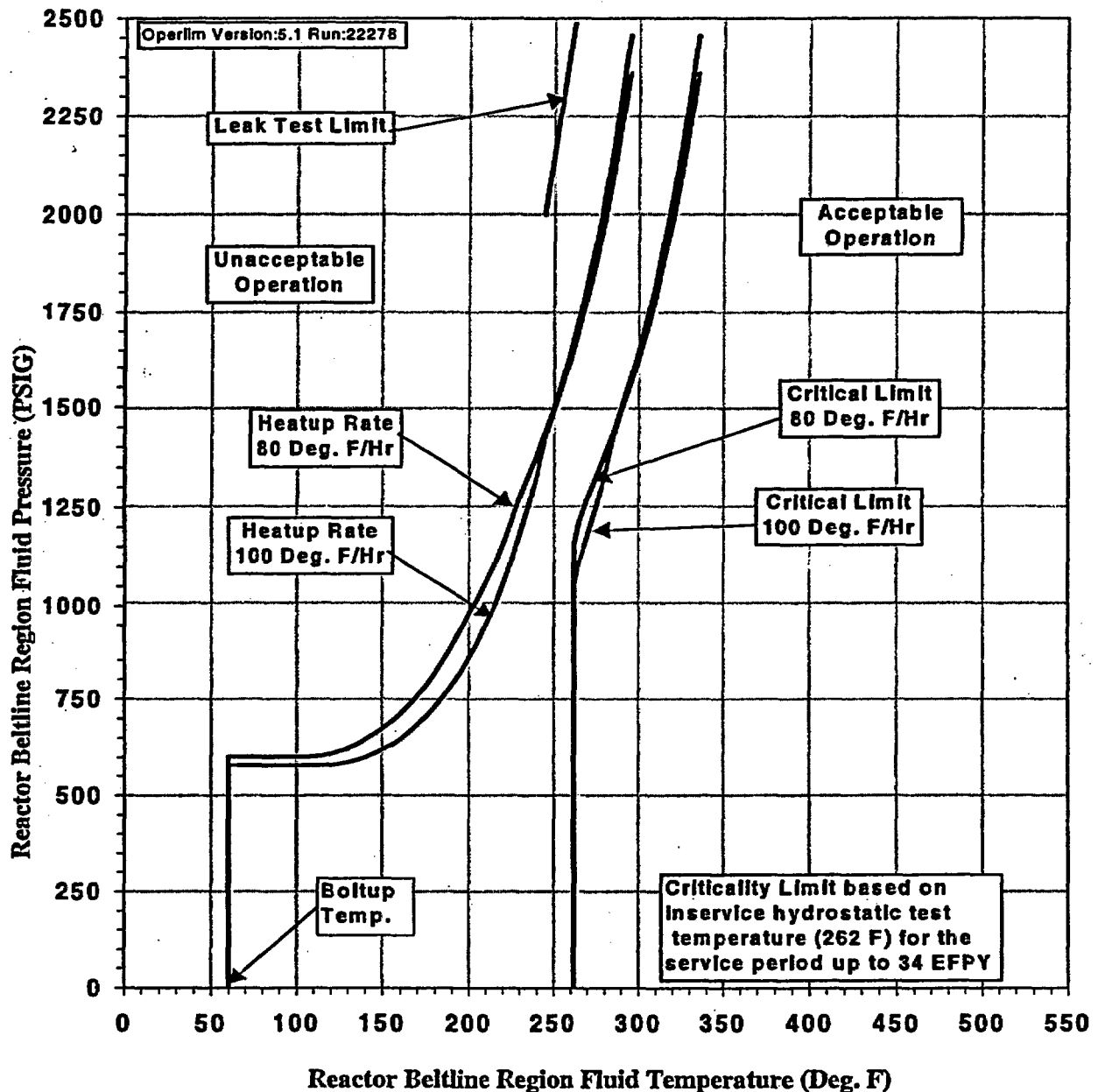


Figure 3.4.3-2 McGuire Unit 1 Reactor Coolant System Heatup Limitations (Heatup Rates of 80 & 100°F/hr) Applicable for the First 34 EFPY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL FORGING 04

LIMITING ART VALUES AT 34 EFPY:
1/4T, 123°F
3/4T, 91°F

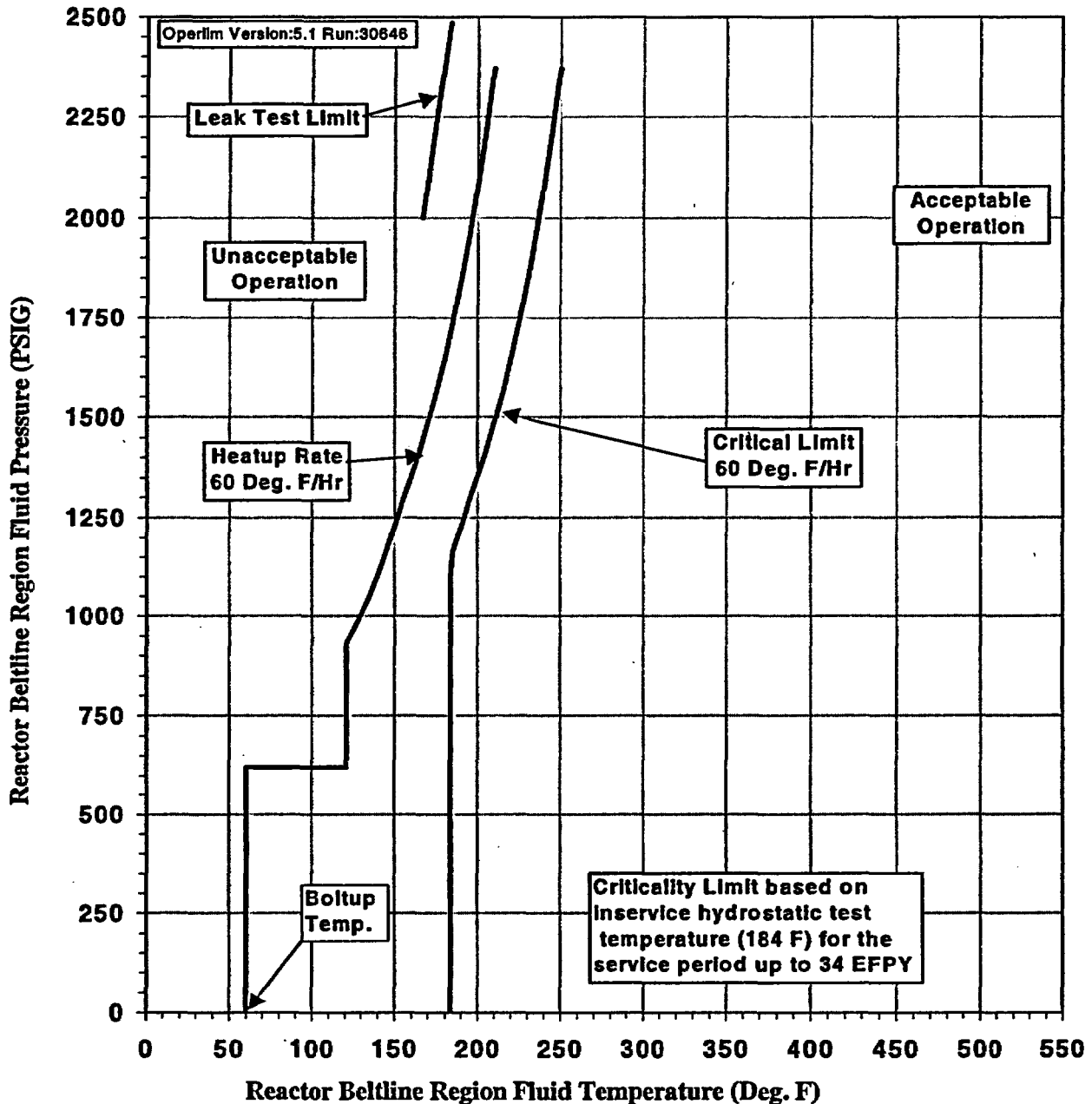


Figure 3.4.3-3 McGuire Unit 2 Reactor Coolant System Heatup Limitations (Heatup Rate of 60°F/hr) Applicable for the First 34 EFPY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL FORGING 04

LIMITING ART VALUES AT 34 EFPY: 1/4T, 123°F
 3/4T, 91°F

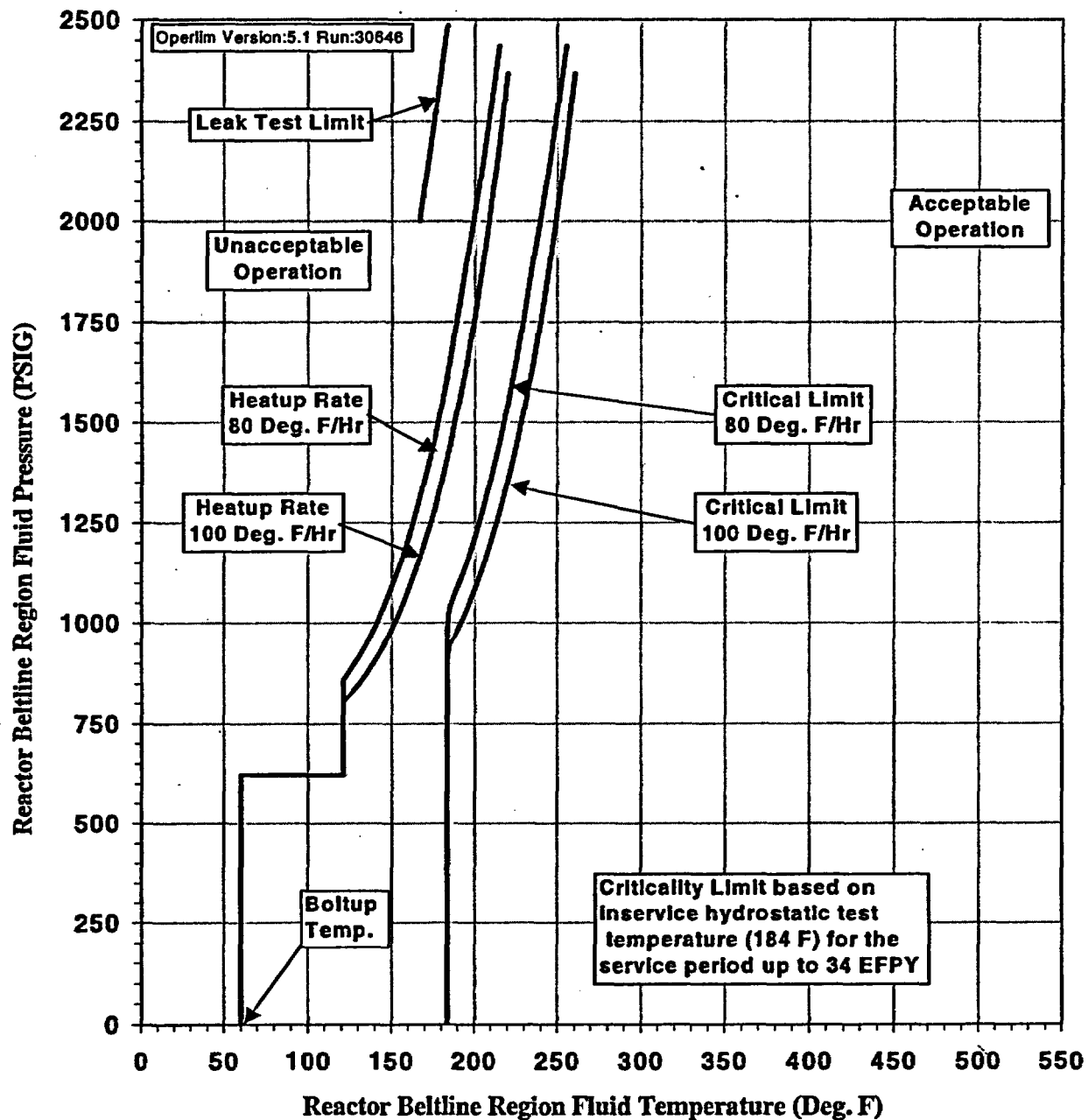


Figure 3.4.3-4 McGuire Unit 2 Reactor Coolant System Heatup Limitations (Heatup Rates of 80 & 100°F/hr) Applicable for the First 34 EFPY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL LONGITUDINAL WELD

LIMITING ART VALUES AT 34 EPFY:

1/4T,	202°F
3/4T,	146°F

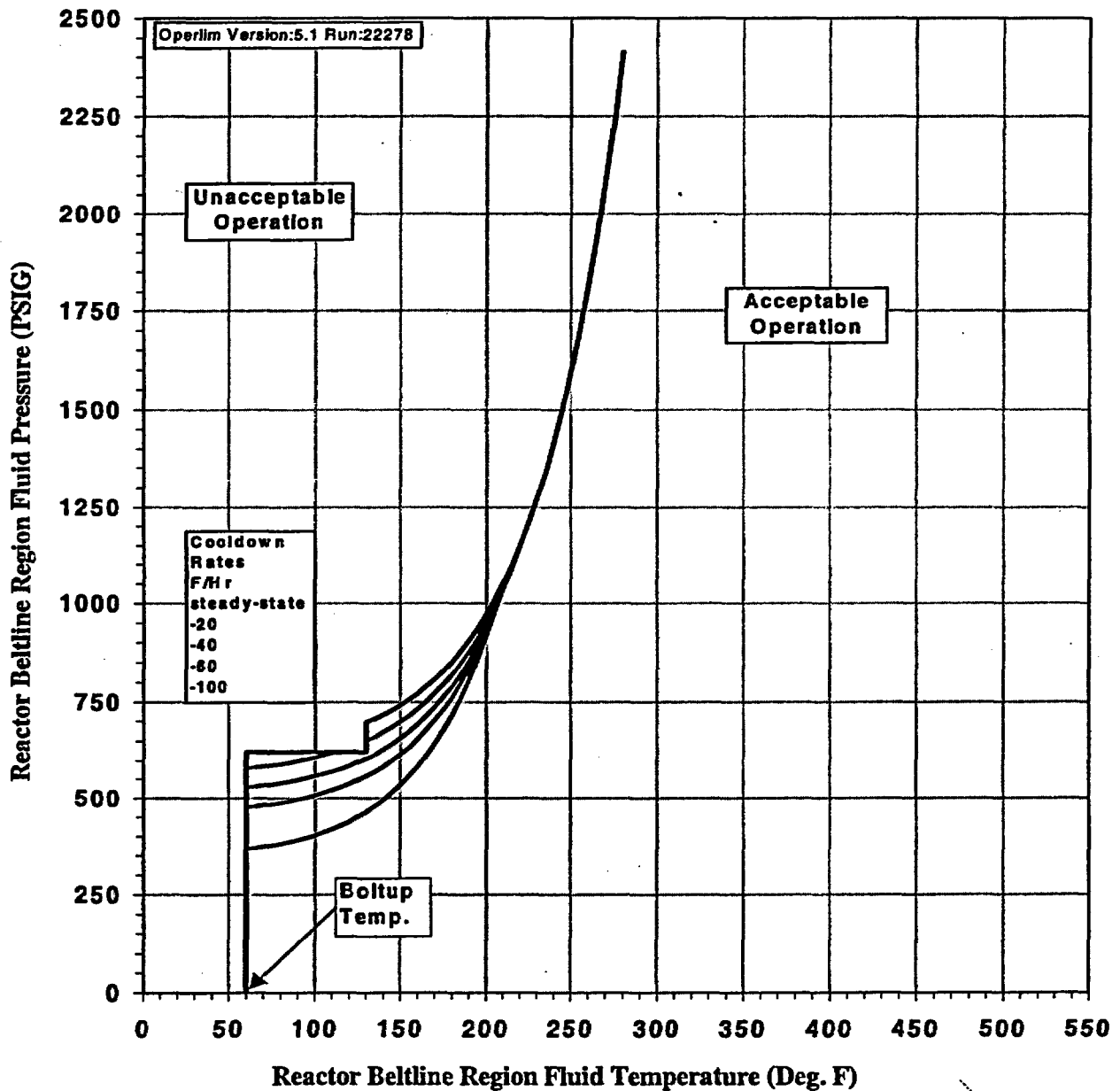


Figure 3.4.3-5 McGuire Unit 1 Reactor Coolant System Cooldown Limitations (Cooldown Rates up to 100°F/hr) Applicable for the First 34 EFPY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

MATERIAL PROPERTY BASIS

LIMITING MATERIAL: LOWER SHELL FORGING 04

LIMITING ART VALUES AT 34 EFPY:

1/4T,	123°F
3/4T,	91°F

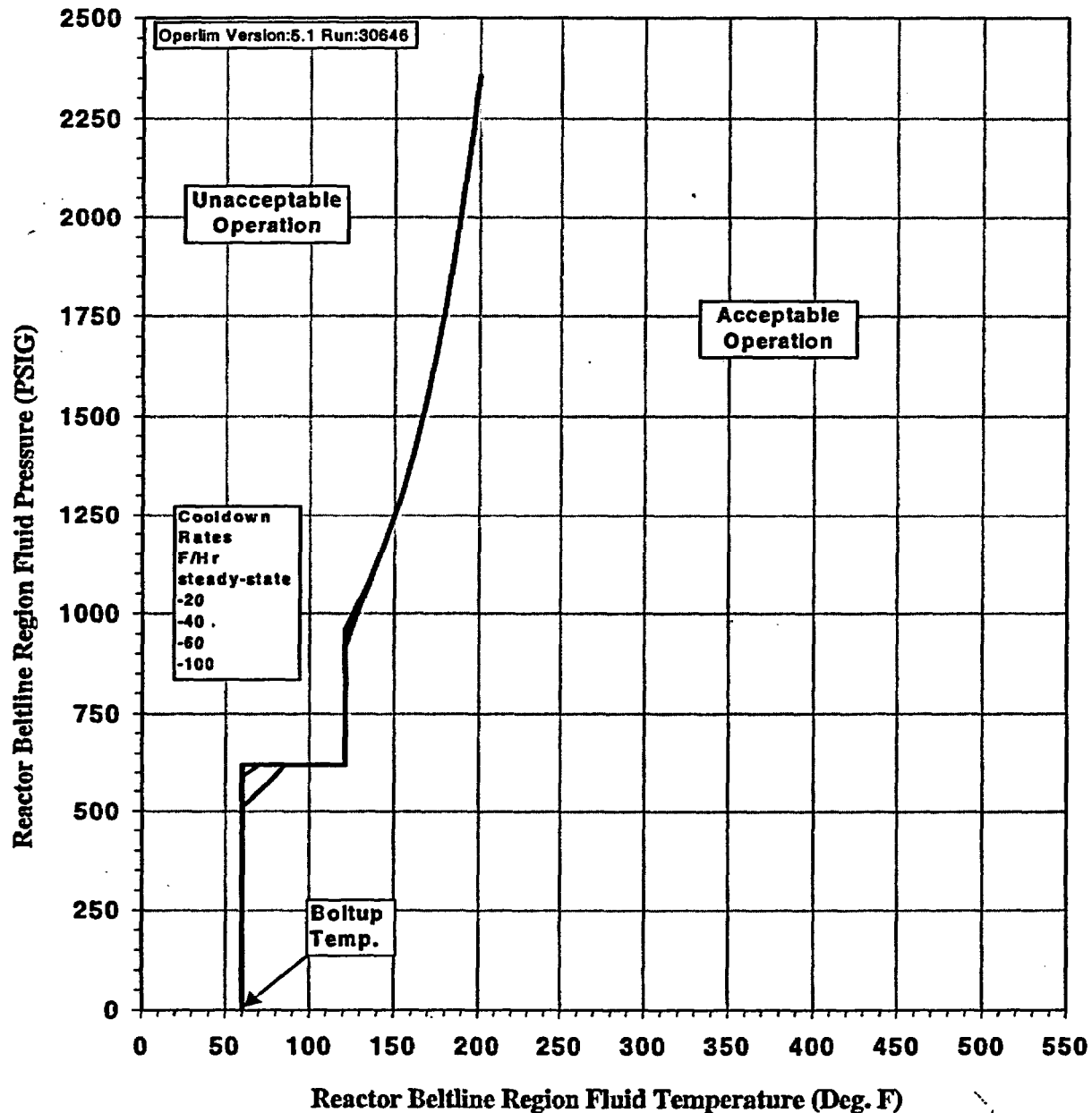


Figure 3.4.3-6 McGuire Unit 2 Reactor Coolant System Cooldown Limitations (Cooldown Rates up to 100°F/hr) Applicable for the First 34 EFY (Without Margins for Instrumentation Errors) Using 1996 App.G Methodology & ASME Code Case N-641

ACTIONS

-----NOTE-----
LCO 3.0.4 is not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>A. Two centrifugal charging pumps capable of injecting into the RCS.</p> <p><u>OR</u></p> <p>One centrifugal charging pump and one safety injection pump capable of injecting into the RCS.</p> <p><u>OR</u></p> <p>Two safety injection pumps capable of injecting into the RCS.</p>	<p>A.1 -----NOTE----- Two centrifugal charging pumps may be capable of injecting into the RCS during pump swap operation for ≤ 15 minutes. ----- Initiate action to verify a maximum of one centrifugal charging pump or one safety injection pump is capable of injecting into the RCS.</p>	Immediately
	<p><u>OR</u></p> <p>A.2.1 Verify RHR suction relief valve is OPERABLE and the suction isolation valves are open.</p>	Immediately
	<p><u>AND</u></p> <p>A.2.2.1 Verify RCS cold leg temperature $> 174^{\circ}\text{F}$ (Unit 1) or $> 89^{\circ}\text{F}$ (Unit 2).</p>	Immediately
	<p><u>OR</u></p> <p>A.2.2.2 Verify RCS cold leg temperature $> 74^{\circ}\text{F}$ and cooldown rate $< 20^{\circ}\text{F/hr}$ (Unit 1), or $> 74^{\circ}\text{F}$ and cooldown rate $< 60^{\circ}\text{F/hr}$ (Unit 2).</p>	Immediately
	<p><u>OR</u></p>	(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.3 Verify two PORVs secured open and associated block valves open and power removed.	Immediately
	<u>OR</u>	
	A.4 Depressurize RCS and establish RCS vent of ≥ 4.5 square inches.	Immediately
	<u>OR</u>	
	A.5.1 Depressurize RCS and establish RCS vent of ≥ 2.75 square inches.	Immediately
	<u>AND</u>	
	A.5.2 Verify two PORVs are OPERABLE.	Immediately
B. An accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in Specification 3.4.3.	B.1 Isolate affected accumulator.	1 hour
C. Required Action and associated Completion Time of Condition B not met.	C.1 Increase RCS cold leg temperature to $> 300^{\circ}\text{F}$.	12 hours
	<u>OR</u>	
	C.2 Depressurize affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed by Specification 3.4.3.	12 hours
D. One PORV inoperable in MODE 4.	D.1 Restore PORV to OPERABLE status.	7 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. One PORV inoperable in MODE 5 or 6.	E.1 Suspend all operations which could lead to a water solid pressurizer.	Immediately
	<u>AND</u> E.2 Restore PORV to OPERABLE status.	24 hours
F. Required Action and associated Completion Time of Condition E not met.	F.1. Verify RCS cold leg temperature > 174°F (Unit 1) or > 89°F (Unit 2).	1 hour
	<u>AND</u> F.2 Verify RHR suction relief valve is OPERABLE and the suction isolation valves are open.	1 hour
G. Two PORVs inoperable. <u>OR</u> Required Action and associated Completion Time of Condition C, D, E, or F not met. <u>OR</u> LTOP System inoperable for any reason other than Condition A, B, C, D, E, or F.	G.1 Depressurize RCS and establish RCS vent of ≥ 2.75 square inches.	8 hours

BASES

BACKGROUND (continued)

Appendix H of 10 CFR 50 (Ref. 4). The operating P/T limit curves will be adjusted, as necessary, based on the evaluation findings and the recommendations of Regulatory Guide 1.99 (Ref. 5).

A second program that employs excor cavity dosimetry to monitor the reactor vessel neutron fluence has been installed in both units. This program meets the requirements of 10 CFR 50 Appendix H (Ref. 4).

The P/T limit curves are composite curves established by superimposing limits derived from stress analyses of those portions of the reactor vessel and head that are the most restrictive. At any specific pressure, temperature, and temperature rate of change, one location within the reactor vessel will dictate the most restrictive limit. Across the span of the P/T limit curves, different locations are more restrictive, and, thus, the curves are composites of the most restrictive regions.

The heatup curve represents a different set of restrictions than the cooldown curve because the directions of the thermal gradients through the vessel wall are reversed. The thermal gradient reversal alters the location of the tensile stress between the outer and inner walls.

The criticality limit curve includes the Reference 1 requirement that it be $\geq 40^{\circ}\text{F}$ above the heatup curve or the cooldown curve, and not less than the minimum permissible temperature for ISLH testing. However, the criticality curve is not operationally limiting; a more restrictive limit exists in LCO 3.4.2, "RCS Minimum Temperature for Criticality."

The consequence of violating the LCO limits is that the RCS has been operated under conditions that can result in brittle failure of the RCPB, possibly leading to a nonisolable leak or loss of coolant accident. In the event these limits are exceeded, an evaluation must be performed to determine the effect on the structural integrity of the RCPB components. The ASME Code, Section XI, Appendix E (Ref. 6), provides a recommended methodology for evaluating an operating event that causes an excursion outside the limits.

APPLICABLE SAFETY ANALYSES

The P/T limits are not derived from Design Basis Accident (DBA) analyses. They are prescribed during normal operation to avoid encountering pressure, temperature, and temperature rate of change conditions that might cause undetected flaws to propagate and cause nonductile failure of the RCPB, an unanalyzed condition. Although the P/T limits are not derived from any DBA, the P/T limits are acceptance limits since they preclude operation in an unanalyzed condition.

RCS P/T limits satisfy Criterion 2 of 10 CFR 50.36 (Ref. 7).

BASES

APPLICABLE SAFETY ANALYSES (continued)

PORV Performance

The fracture mechanics analyses show that the vessel is protected when the PORVs are set to open at or below the specified limit. The setpoints are derived by analyses that model the performance of the LTOP System, assuming the limiting LTOP transient of one centrifugal charging pump or one safety injection pump injecting into the RCS. These analyses consider pressure overshoot and undershoot beyond the PORV opening and closing, resulting from signal processing and valve stroke times. The PORV setpoints at or below the derived limit ensures the Reference 1 P/T limits will be met.

The PORV setpoints will be updated when the revised P/T limits conflict with the LTOP analysis limits. The P/T limits are periodically modified as the reactor vessel material toughness decreases due to neutron embrittlement caused by neutron irradiation. Revised limits are determined using neutron fluence projections and the results of examinations of the reactor vessel material irradiation surveillance specimens. The Bases for LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits," discuss these examinations.

The PORVs are considered active components. Thus, the failure of one PORV is assumed to represent the worst case, single active failure.

RCS Vent Performance

With the RCS depressurized, analyses show a vent size of 2.75 square inches is capable of mitigating the allowed LTOP overpressure transient. The capacity of a vent this size is greater than the flow of the limiting transient for the LTOP configuration, one centrifugal charging pump or one safety injection pump OPERABLE, maintaining RCS pressure less than the maximum pressure on the P/T limit curve.

The RCS vent size will be re-evaluated for compliance each time the P/T limit curves are revised based on the results of the vessel material surveillance.

The RCS vent is passive and is not subject to active failure.

The LTOP System satisfies Criterion 2 of 10 CFR 50.36 (Ref. 7).

BASES

LCO

This LCO requires that the LTOP System is OPERABLE. The LTOP System is OPERABLE when the minimum coolant input and pressure relief capabilities are OPERABLE. Violation of this LCO could lead to the loss of low temperature overpressure mitigation and violation of the Reference 1 limits as a result of an operational transient.

To limit the coolant input capability, the LCO permits a maximum of one centrifugal charging pump or one safety injection pump capable of injecting into the RCS and requires all accumulator discharge isolation valves closed and immobilized when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed in LCO 3.4.3.

The elements of the LCO that provide low temperature overpressure mitigation through pressure relief are:

- a. Two OPERABLE PORVs (NC-32B and NC-34A); or

A PORV is OPERABLE for LTOP when its block valve is open, its lift setpoint is set to the specified limit and testing proves its automatic ability to open at this setpoint, and motive power is available to the valve and its control circuit.

- b. A depressurized RCS and an RCS vent.

An RCS vent is OPERABLE when open with an area of ≥ 2.75 square inches.

Each of these methods of overpressure prevention is capable of mitigating the limiting LTOP transient.

The LCO is modified with a note that specifies that a PORV secured in the open position may be used to meet the RCS vent requirement provided that its associated block valve is open and power removed. With the PORV physically secured or locked in the open position with its associated block valve open and power removed, this vent path is passive and is not subject to active failure.

APPLICABILITY

This LCO is applicable in MODE 4 when any RCS cold leg temperature is $\leq 300^{\circ}\text{F}$, in MODE 5, and in MODE 6 when the reactor vessel head is on. The pressurizer safety valves provide overpressure protection that meets the Reference 1 P/T limits above 300°F . When the reactor vessel head is off, overpressurization cannot occur.

LCO 3.4.3 provides the operational P/T limits for all MODES. LCO 3.4.10, "Pressurizer Safety Valves," requires the OPERABILITY of

BASES

APPLICABILITY (continued)

the pressurizer safety valves that provide overpressure protection during MODES 1, 2, and 3, and MODE 4 above 300°F.

Low temperature overpressure prevention is most critical during shutdown when the RCS is water solid, and a mass or heat input transient can cause a very rapid increase in RCS pressure when little or no time allows operator action to mitigate the event.

The Applicability is modified by a Note stating that accumulator isolation is only required when the accumulator pressure is more than or at the maximum RCS pressure for the existing temperature, as allowed by the P/T limit curves. This Note permits the accumulator discharge isolation valve Surveillance to be performed only under these pressure and temperature conditions.

ACTIONS

LCO 3.0.4 is not applicable for entry into LTOP operation.

A.1, A.2.1, A.2.2.1, A.2.2.2, A.3, A.4, A.5.1, and A.5.2

With two centrifugal charging pumps, safety injection pumps, or a combination of each, capable of injecting into the RCS, RCS overpressurization is possible.

To immediately initiate action to restore restricted coolant input capability to the RCS reflects the urgency of removing the RCS from this condition. Two pumps may be capable of injecting into the RCS provided the RHR suction relief valve is OPERABLE with:

1. RCS cold leg temperature > 174°F (Unit 1), or
2. RCS cold leg temperature > 89°F (Unit 2), or
3. RCS cold leg temperature > 74°F and cooldown rate < 20°F/hr (Unit 1),
or
4. RCS cold leg temperature > 74°F and cooldown rate < 60°F/hr (Unit 2),
or
5. two PORVs secured open with associated block valves open and power removed, or
6. a RCS vent of ≥ 4.5 square inches, or
7. a RCS vent of ≥ 2.75 square inches and two OPERABLE PORVs (the RCS vent shall not be one of the two OPERABLE PORVs).

For cases where no reactor coolant pumps are in operation, RCS cold leg temperature limits are to be met by monitoring of BOTH the WR Cold Leg temperatures and Residual Heat Removal Heat Exchanger discharge temperature. With both PORVS and block valves secured open, or with

BASES

ACTIONS (continued)

active failure of the remaining valve path during this time period is very low.

E.1 and E.2

The consequences of operational events that will overpressurize the RCS are more severe at lower temperature (Ref. 8). Thus, with one of the two PORVs inoperable in MODE 5 or in MODE 6 with the head on, all operations which could lead to a water solid pressurizer must be suspended immediately and the Completion Time to restore two valves to OPERABLE status is 24 hours.

The Completion Time represents a reasonable time to investigate and repair several types of relief valve failures without exposure to a lengthy period with only one OPERABLE PORV to protect against overpressure events.

F.1 and F.2

If the Required Actions and associated Completion Times of Condition E are not met, then alternative actions are necessary to establish the required redundancy in relief capacity. This is accomplished by verifying that the RHR relief valve is OPERABLE and the RHR suction isolation valves open and the RCS cold leg temperature > 174°F (Unit 1) or > 89°F (Unit 2). For cases where no reactor coolant pumps are in operation, RCS cold leg temperature limits are to be met by monitoring of BOTH the WR Cold Leg temperatures and Residual Heat Removal Heat Exchanger discharge temperature. The Completion Time of 1 hour reflects the importance of restoring the required redundancy at lower RCS temperatures.

G.1

The RCS must be depressurized and a vent must be established within 8 hours when:

- a. Both required PORVs are inoperable; or
- b. A Required Action and associated Completion Time of Condition C, D, E, or F is not met; or