LaSalle Main Steam Tunnel Temperature Response for Linear Leakage Ramp Rate Sensitivities

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Abstract

The LaSalle main steam tunnel (MST) leak detection system consists of temperature sensors that monitor the MST temperature and ventilation system supply and exhaust air temperatures. There will be an automatic isolation signal, as the automatic isolation signal is based on differential temperatures resulting from a 100 gpm steam leak using a linear leakage ramp rate of 100 seconds. This calculation uses a GOTHIC system model to determine the MST temperature response due to a 100 gpm steam leak, VR supply air temperatures of 110 degrees F, and a variety of linear leakage ramp rates. The results are intended to be used to determine the sensitivity of ramp rate on upper MST temperature.

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1. Introduction

The LaSalle main steam tunnel (MST) leak detection system consists of temperature sensors that monitor the MST temperature and ventilation system supply and exhaust air temperatures. There will be an automatic isolation signal, as the automatic isolation signal is based on differential temperatures resulting from a 100 gpm steam leak using a linear leakage ramp rate of 100 seconds. This calculation uses the bounding conditions from the Reference 1 analysis and a variety of linear leakage ramp rates. The results are intended to be used to determine the sensitivity of ramp rate on upper MST temperature.

The purpose of this calculation is to determine the MST temperature response due to a variety of leakage ramp rates for the bounding conditions determined in Reference 1. The results are intended to be used to show that the upper MST temperature is insensitive to the leakage ramp rate.

This sensitivity study is being performed to address an RAI on the LaSalle MST temperature setpoint methodology change. RAI 4 and its response can be found in Reference 2.

2. Methodology/Model Description and Assumptions

The main steam tunnel temperature response was calculated by a GOTHIC system model. The steam tunnel configuration, the transient due to a steam leak, the analytical model, the computer code, the input parameters and the assumptions used in this analysis are identical to those used in Reference with the following exception. Assumption 11 in Reference 1, section 2.5 is the starting point for the sensitivity study. Including this base case, five GOTHIC runs were made. The following leakage ramp rates were used: 0.001 seconds, 50 seconds, 100 seconds, 500 seconds and 1000 seconds. This was accomplished by changing one number in a function table for each case.

3. Model Benchmark

The validity of the analytical model is established by comparing the GOTHIC model results with plant measured data. Figure 3 from Reference 1 shows the benchmark data. This plot shows very good agreement between the calculated results and plant data.

4. Results

Figure 1 shows the upper MST temperature response as a result of a 100 gpm of steam leakage for all five leakage ramp rates. The leak is initiated at time equal to 1000 seconds. Within the first ten minutes the upper MST temperature shows up to 1.3 degrees difference between the different leakage ramp rates. However, within 30 minutes (steady state achieved) the upper MST varies by only 0.1 degrees for the different leakage ramp rates.

The results presented in Figure 1 are also listed in Tables 1 and 2.

Table 1 :Steam Tunnel Temperature Variations with Linear Leakage Ramp Rate approximately 10 Minutes (8.33 minutes) after Fully Developed Leakage

Linear Ramp Rate (seconds)	Upper Steam Tunnel Temperature (F)	Lower Steam Tunnel Temperature (F)	Middle Steam Tunnel Temperature (F)
0	182.7	206.3	206.9
50	182.5	204.9	205.6
100	182.5	204.8	205.6
500	181.4	203.9	204.0
1000	181.8	204.5	206.1

Table 2 :Steam Tunnel Temperature Variations with Linear Leakage Ramp Rate approximately 30 Minutes (28.33 minutes) after Fully Developed Leakage

Linear Ramp Rate (seconds)	Upper Steam Tunnel Temperature (F)	Lower Steam Tunnel Temperature (F)	Middle Steam Tunnel Temperature (F)
0	183.3	207.0	207.3
50	183.3	207.0	207.2
100	183.3	207.0	207.3
500	183.4	207.3	207.5
1000	183.4	207.5	207.7

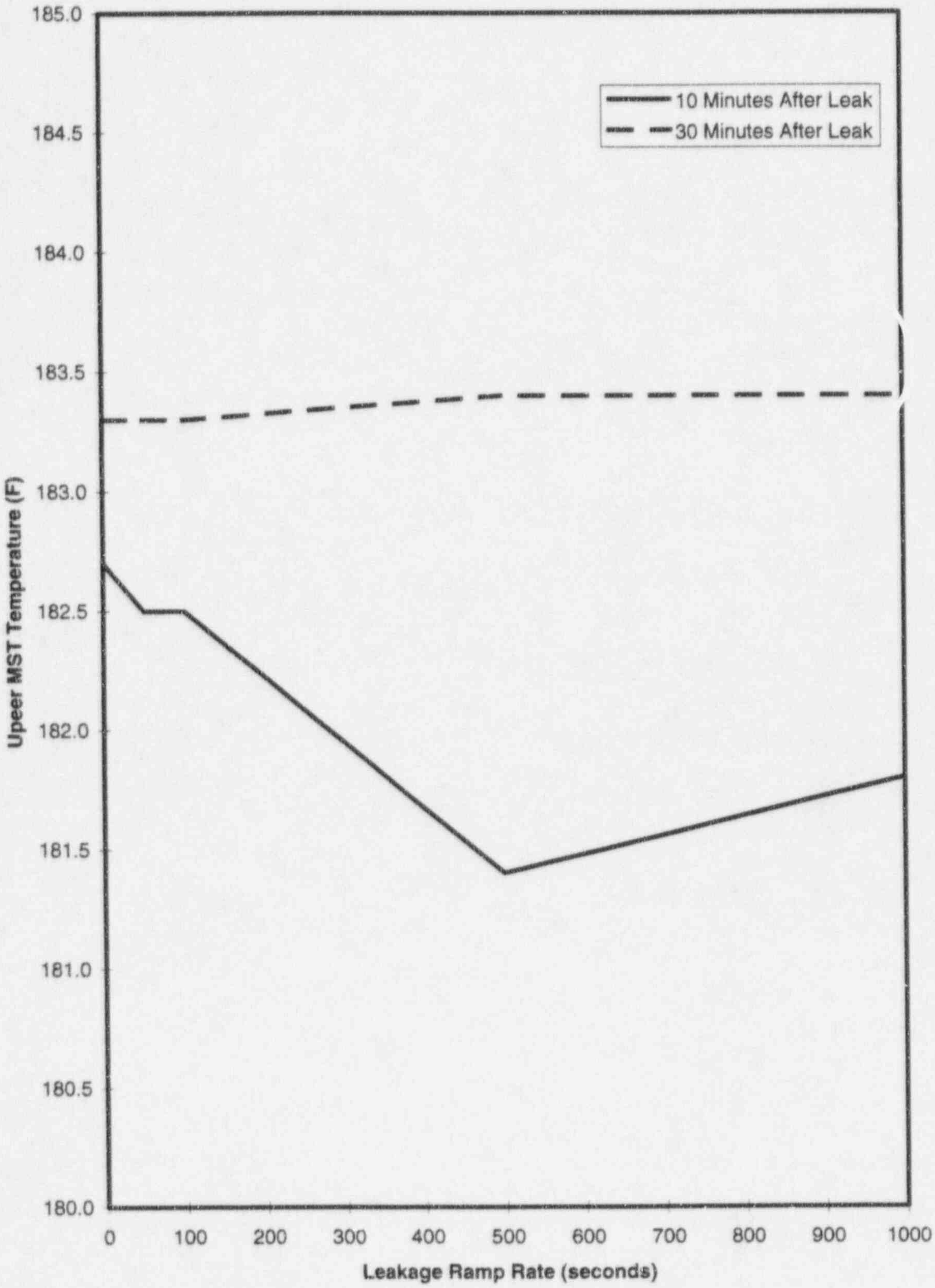

Figure 1: Upper MST Temperature Response for Various Leakage Ramp Rates

5. Conclusions/Discussion

Table 1 showed the results for the specified ramp rate 10 minutes after the leak has fully developed which is consistent with the values listed in Reference 1. Table 2 showed the results for the ramp rate 30 minutes after the leak has fully developed. Although there are variations of approximately 1.3 degrees in Table 1 for the upper MST, this is not a concern since the temperatures continue to increase. Table 2 shows that once these temperatures reach a true steady state there is less than 0.1 degrees variations in the upper MST because of the ramp rate. The results show that the steam tunnel temperature response is relatively insensitive to the linear leakage ramp rate. For consistency with values in Reference 1, values at 8.33 minutes and 28.33 minutes after fully developed leakage were used. Hence the upper MST temperature response is insensitive to variations in the leakage ramp rate.

6. References

1) BSA-L-95-05, Revision 0, "LaSalle Main Steam Tunnel Temperature Response Due to Steam Leakage with Ventilation System in Operation", January 13, 1996

2) NFS:BSA:96-020, Memo to File, "Verification of GOTHIC runs for LaSalle main Steam Tunnel RAI 4," February 23, 1996

Appendix A - Microfiche Index

Microfiche ID	# of fiche	Description
NFSEBX 1234	1	0.001 Second ramp rate
NFSEBX 1234	1	50.0 Second ramp rate
NFSEBX 1234	1	100.0 Second ramp rate
NFSEBX 1234	1	500.0 Second ramp rate
NFSEBX 1234	1	1000.0 Second ramp rate

Appendix B - Input Data Set Protection Form

Station: LS **Unit:** both **Cycle/Analysis:** all

	Current File Location[1]	(Shaded Area for SA Admin. Only) Copy To[2]	CheckSum #[3]	
			sum -r	sum -p
1.	/nfs/sa/nfseb/gothic/ls/ramp/new/v400_v667/rampsens/0ramp		11751	2534531472
2.	/nfs/sa/nfseb/gothic/ls/ramp/new/v400_v667/rampsens/50ramp		48807	1833529052
3.	/nfs/sa/nfseb/gothic/ls/ramp/new/v400_v667/rampsens/100ramp		48240	3425756220
4.	/nfs/sa/nfseb/gothic/ls/ramp/new/v400_v667/rampsens/500ramp		30011	3268254251
5.	/nfs/sa/nfseb/gothic/ls/ramp/new/v400_v667/rampsens1000ramp		49176	1974590145

Notes:
1) **/nfs/sa** is not required. Begin each file location with user id. File name should be descriptive and include a means of identifying associated computer code.
2) Station, Unit, and Cycle/Analysis will define part of the destination location in **/nfs.databank/SA** therefore, these are not need in the "Copy To" column.
3) The SA Admin will place a check mark next to the verified checksum numbers.

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