October 24, 2000

MEMORANDUM TO: A. Randolph Blough, Director
Division of Reactor Projects
Region I

FROM: Suzanne C. Black, Deputy Director ***/RA/***
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

SUBJECT: NRR RESPONSE TO TASK INTERFACE AGREEMENT (TIA) 2000-01, R.E. GINNA NUCLEAR POWER PLANT - ACCEPTABILITY OF CALCULATIONS USED TO DETERMINE THE OPERABILITY OF THE MAIN STEAM NON-RETURN CHECK VALVES (TAC NO. MA7271)

By memorandum dated December 8, 1999 (TIA 2000-01; ADAMS Accession Number ML003727788) you requested technical assistance from the Office of Nuclear Reactor Regulation to validate the technical adequacy of the Rochester Gas and Electric's calculations used to support the current operability of the main steam non-return check valves and determine if the licensee has provided an adequate basis for demonstrating that operability.

The Reactor Systems Branch (SRXB) has completed its evaluation and determined that there should be sufficient margin in available closing torque to close the check valves at the maximum flow rate of 881.6 lbm/sec from the LOFTRAN calculation. Attached is the SRXB response that resolves this issue.

This completes NRR's review of TIA 2000-01 and closes TAC NO. MA7271.

Docket No. 50-333

Attachment: As stated

cc w/att: L. R. Plisco, Region II
G.E. Grant, Region III
K.E. Brockman, Region IV

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RESPONSE TO REGION I TASK INTERFACE AGREEMENT (TIA) 2000-01,
ACCEPTABILITY OF CALCULATIONS USED TO DETERMINE THE OPERABILITY OF THE MAIN STEAM NON-RETURN CHECK VALVES,
R.E. GINNA NUCLEAR POWER PLANT

By memorandum dated December 8, 1999 (TIA 2000-01), you requested technical assistance from the Office of Nuclear Reactor Regulation to validate the technical adequacy of the Rochester Gas and Electric's (RG&E's) calculations used to support the current operability of the main steam non-return check valves and determine if the licensee has provided an adequate basis for demonstrating that operability.

On April 27, 2000, the SRXB issued a memorandum, that provided a preliminary assessment of the available closing torque indicating it was not adequate to close the valves. Since then NRR has had a meeting with Region 1 and RG&E on May 9, 2000, to discuss the preliminary evaluation and the RG&E calculations.

In 1992, the valve packing on the main steam line non-return check valves at the Ginna plant was tightened to address problems with packing leakage and valve flutter. The tighter packing changed the valves from free swinging gravity closing valves to valves that nominally require 600 ft-lbs of torque to close. During the operating cycle that commenced in 1997, the measured minimum torque required to close the valve increased from ~600 ft-lbs to ~900 ft-lbs. The 50.59 analysis supporting the 1992 valve packing change was reviewed during NRC inspection 99-05 and errors were noted with the closing torque calculation by a member of the inspection team. As a followup to the inspection, requests for additional information (RAIs) were sent to RG&E about the calculations. RG&E responded to the RAIs in a letter dated September 24, 1999. Duke Engineering, under contract to RG&E, also reviewed the calculation. Since the inspection, the valve counterweights were adjusted to reduce the minimum required closing torque to ~750 ft-lbs.

The closing torque on the check valve depends on both the flow rate in the steam line and the geometry of the valve. The closing torque on the valve should increase with an increase in steam flow rate. RG&E determined that the minimum flow rate of concern would be due to the break size at which the containment pressure reaches the design pressure if the check valve does not close. Westinghouse LOFTRAN and containment calculations were used to determine the limiting minimum break size and flow rates of concern. The LOFTRAN calculated flow rates appear to be reasonable for the break size that was analyzed. The containment pressure response from this break was not reviewed.

RG&E then used the flow rate information to calculate the minimum closing torque on the swing disk check valve. The calculation decomposes the forces on the check valve into a drag force that is calculated using a drag coefficient and the net pressure force due to summing up all pressure forces over both valve faces. The pressure force is what is commonly called the lift force. Although RG&E's pressure force calculation on page 9 of DA-ME-92-147 is based on assumptions that cannot be verified without experimental data or detailed computational fluid dynamics calculations, it can be used to calculate an effective lift coefficient of ~1.04 based on the velocity of the steam upstream of the valve. The torque available to close the valve was calculated by RG&E to be 912 ft-lb at a flow rate of 603.3 lbm/sec. The calculated torque

available to close the valve would be 1947 ft-lb at the calculated peak mass flow rate of 881.6 lbm/sec from the LOFTRAN calculation of the largest break that will not exceed the containment design pressure.

An independent assessment of the RG&E check valve closure analysis was performed by Duke Engineering and Services (DE&S). This document (Duke Engineering and Services Report RG0007-T14-001, "Assessment of Main Steam Non-Return Check Valve Closure Analysis," Rev. 0) was provided to the staff as an attachment to a letter dated March 14, 2000, and was reviewed as part of the TIA. The independent analysis relies on empirical flow coefficients from tilting disk and butterfly check valves that are not applicable to the swing disk check valve geometry, but they should provide a reasonable estimate of the torque available to close the valve. It is possible that the closing torque of the Ginna swing disk check valve is less than the torque calculated from either of the empirical flow coefficients that were evaluated since less than half of the valve area is exposed to the free stream flow field for the Ginna valve. The full valve area is exposed to the free stream for the tilting disk and butterfly check valves. It is unlikely that the closing torque for the Ginna swing disk check valve could exceed the torque calculated using the empirical coefficients measured for the butterfly valve since the butterfly valve has the most favorable geometry for valve closure due to fluid forces. The DE&S report also recommends rework and/or repair of the valve and states that experimental data is needed to validate any analytical method used to calculate the closing torque on the check valve. Applying the measured tilting disk flow coefficients gives a calculated closing torque of 612.9 ft-lb at 603.3 lbm/sec and 1308.6 ft-lb at 881.6 lbm/sec. Applying the measured butterfly flow coefficients gives a calculated closing torque of 816.7 ft-lb at 603.3 lbm/sec and 1743.9 ft-lb at 881.6 lbm/sec. The calculated effective lift coefficients for each of these configurations will be less than 1.

The DE&S results indicate that the calculated available closing torque at a flow rate of 603.3 lbm/sec used in RG&E calculation DA-ME-92-147 is not adequate to close the valve if the measured flow coefficients from the tilting disk check valve are used to calculate the available torque to close the valve and the minimum required closing torque is 750 ft-lb. The calculated closing torque is marginally adequate if the flow coefficients from the butterfly valve are valid. At a flow rate of 881.6 lbm/sec there is a calculated margin ranging from several hundred ft-lbs to a thousand ft-lbs for the closing torque using either set of empirical flow coefficients. The calculated margin to a minimum required closing torque of 750 ft-lb using the empirical coefficients for the tilting disk check valve is 74 percent at 881.6 lbm/sec. It is acceptable to use a flow rate higher than the 603.3 lbm/sec minimum flow rate since the calculated peak flow is 881.6 lbm/sec and the calculated valve closure time will be less than 1 second for torque margins greater than 100 ft-lbs based on an estimate of 50 slug-ft$^2$ for the moment of inertia of the valve and counterweights about the valve hinge pin. It takes approximately 6 seconds for the calculated flow rate to decrease to 603.3 lbm/sec from its maximum value. RG&E stated in the May 9, 2000, meeting with the NRC staff that there is still valve chatter at the full forward steam flow rate of 914 lbm/sec. Since the fluid forces on the valve in the forward flow direction should be similar in magnitude to the reverse flow forces at a given flow rate, the valve chatter indicates that the maximum calculated reverse flow rate of 881.6 lbm/sec should be adequate to initiate valve closure.

The SRXB staff has reevaluated the available closing torque on the Ginna check valve to address the time period between the point when the valve packing was tightened to when the

valve counterweights were adjusted and believes the closing torque will be greater than previously estimated. The original RG&E calculation was nonconservative in concluding that a mass flow rate of 603.3 lbm/sec would be sufficient to exceed the 900 ft-lbs required closing torque and result in a successful valve closure. However, the additional analysis by DE&S showed that there would have been sufficient margin in available closing torque to close the check valve at the maximum flow rate of 881.6 lbm/sec from the LOFTRAN calculation. Therefore, the valve was able to perform its design function in this configuration. The changes that the licensee made to the valve counterweights reduced the required closing torque for the valve and increased the available margin. Based on the above, the SRXB staff concludes that the revised calculations are acceptable and that the main steam non-return check valves have remained operable since the packing was originally adjusted in 1992.