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4-24-2025

Document Control Desk
U.S Nuclear Regulatory Commission
Washington D.C. 20555-0001

Subject: ASCO NP8321 series valves do not shift or partially shift after periods of extended de-energization

References:

A. ASCO L.P. RMA#86759 evaluation dated 1-05-2024
B. Discussion with Ron Wise on 2/25/2025
C. Follow-up letter dated 4-11-2025 sent to Framatome
D. ASCO NP8321 series valves distribution notice to end customers dated 4-21-2025

The enclosed information relates to a single NPKX8321A1E/10688 120/60 VAC valve identified by Dominion Energy North Anna. Customer states that this solenoid operated valve (SOV) is normally de-energized with about 40-45 PSI of air. The valve did not shift or partially shift after periods of extended de-energization.

ASCO does not have adequate knowledge of the actual installation and operating condition of this valve to determine whether this condition would create a "substantial safety hazard" as defined in 10CFR21.3. This information is intended to provide investigation results and recommendations.

Testing:
The ASCO NP8321 valve series and all ASCO NP series valves were qualified to sit in a normally energized position and were not tested for extended periods of de-energization per qualification report AQR-21678 & AQR-67368. The U-cup seal was tested and ASCO determined that this U-cup seal experienced low pressure de-energized dormancy performance limitations below 40 PSI where the valve did not shift completely to an energized state.

Recommendation:
An alternative valve (NP8300) is recommended by ASCO for this customer application. In the interim, ASCO recommends increasing the inlet pressure to the valve to at least 80 PSI not to exceed the maximum 150 PSI to conservatively ensure proper operation of the NP8321 series valve in a de-energized state.

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Conclusion:
ASCO concludes based on design and known operating experience that only the NP8321 valve has a known low pressure dormancy condition which could cause the valve to not operate properly when shifting to an energized position. ASCO L.P. cannot determine Part 21 applicability. Each end user needs to perform their own evaluation based on the information provided in this notification.

If you have any questions regarding this evaluation, please contact me at (803) 641-9355 or Bryan.Causey@Emerson.com

Best Regards,

Bryan Causey
Quality Engineer

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1-05-2024

Framatome Inc.
3315 Old Forest Rd.
Lynchburg, VA 24501
Attn: Hunter Steele/Chris Marsh

Ref: Framatome PO #1021032546

ASCO L.P. RMA#86759

Customer Complaint:

Dominion Energy North Anna SOV NPKX8321A1E 10688 120/60 S/N: A28103603-001 is normally de-energized with about 40-45 PSI of air. It is periodically called upon to energize and shift a Fisher Globe valve and a Fisher diaphragm actuator. The valve fails to shift or partially shift after periods of extended de-energization. Valves produced after 2018 had to be replaced more frequently than previously.

ASCO evaluation:

ASCO LP evaluated the valve and found that the valve passed baseline functional testing as required prior to shipping. The valve shifted from 150 psi to 15 psi and passed leak check requirements. ASCO LP then put the valve in an environmental chamber at 100°C for an extended period, periodically checking operation at various pressures. ASCO LP found that at the stated inlet pressure of at least 40 psi, the valve performed as expected, but when pressure was reduced to 35 psi and tested after extended periods of time the valve shifted to a mid-position, unable to shift a small test actuator with air excessively leaking from the exhaust port.

Conclusion:

Due to the unique operating conditions of this valve as most NP8321 valves sit in a energize position for extended periods of time, this condition would not be present except for cases when the valve sits for extended periods of de-energization, this allows the U-cup to stay pressurized. When the valve shifts to the energized position, the pressure on the U-cup is vented and the U-cup must move approximately ¼ of an inch for the valve to fully shift. If there is significant friction from the U-cup, this can cause the valve to shift to a mid-position where all the ports are open to exhaust, unable to pressurize the cylinder port. This condition would not result in a substantial safety hazard therefor, there is no necessity per the requirements of 10 CFR Part 21 to report this issue.

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The ASCO NP8321 valve series and all ASCO NP series valves was qualified to sit in a normally energized position and wasn't tested for extended periods of de-energization per qualification report AQR-21678. For conditions like the described use case, with the valve sitting for extended periods of de-energization, ASCO LP recommends using ASCO NP series NP8300383ERF valve with 100 PSI pressure rating and 1/3 the cylinder to exhaust flow of the NP8321 and 75% of inlet to cylinder flow. Or if your system can handle internal valve leakage of 1.5 SCFH to exhaust, a NP8300383EF with 60% cylinder to exhaust flow and the same inlet to cylinder flow of the NP8321A1E valve. This is a direct acting valve that does not require a minimum pressure differential to shift positions. The NP8300 series is available with the same screw terminal and ½" conduit connection options.

If you have any questions regarding this evaluation, please contact me at 803-641-9355 or Bryan.Causey@emerson.com.

Bryan Causey
Technical Service Engineer

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4-24-2025

Ref: Discussion with Ron Wise regarding ASCO NP8321 series valves

Meeting overview:

On 2/25/2025 a meeting took place with Ron wise regarding ASCO NP8321 series and the letter dated 1-05-2024 for RMA 86759 based on follow up questions referenced below. Nick Ingles, Sr. Product Engineer ASCO valve, Paul Cetrulo, Technical Support Specialist Navy/Nuclear for ASCO valve and Ron Wise, Technical Consultant to the NUGEQ.

Follow up the questions (abbreviated):

1. Has ASCO taken the position that the testing in AQS-21678-TR (as well as AQR-67368) only demonstrates qualification for normally energized applications?

2. Is this position limited to NP8321 series or any other models with U-cups of valves with a minimum differential pressure requirement?

3. What assurance can ASCO provide that the observed issue with a normally de-energized NP8321 not shifting when energized is not relevant or applicable to a normally energized NP8321 that must shift when de-energized?

4. Please explain how this is a design application issue when the failures did not occur with the originally installed valves, but did occur after their replacement? Operating history seems to imply that there has been a change in the performance capability of the NP8321 over time.

5. Did ASCO disassemble the NPKX8321A1E from 1-SV-TV-103 to verify that the failure to shift was not the result of foreign material, excessive or degraded lubricant, deposits, or elastomer degradation?

6. Given that the test specimens in AQS-21678-TR (and AQR-67368) where thermally aged while energized, do you agree that this thermal aging approach (in and by itself) would not preclude the use of NP series SOVs in normally de-energized or intermittent duty applications?

Conclusion:

The meeting concluded with ASCO tasked with clarifying our position on the NP8321 being used in de-energized positions for long periods, expanding on how other NP series valves are not affected by being in a de-energized position for long periods, and further supporting evidence for our conclusions in letter 1-05-24. This resulted in letters dated 4-11-2025 to Framatome, followed by a discussion with Framatome about the results and an added letter dated 4-21-2025 clarifying our position for all users of the NP8321 series.

Nick Ingles | Senior Product Engineer | **ASCO**
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4-11-2025

Framatome Inc.
3315 Old Forest Rd.
Lynchburg, VA 24501
Attn: Hunter Steele/Chris Marsh
Ref: Follow-up letter on RMA#86759
ASCO NP8321 series valves

Reported non-conformance:

Dominion Energy North Anna SOV NPKX8321A1E 10688 120/60 is normally energized with about 40-45 PSI of air. It is periodically called upon to energize and shift a Fisher Globe valve and a Fisher diaphragm actuator. The valve does not shift or partially shift after periods of extended de-energization. Valves produced after 2018 had to be replaced more frequently than previously. Reference ASCO letter dated 1-05-2024 with RMA 86759 for more information.

ASCO qualification testing:

The ASCO NP8321 valve series and all ASCO NP series valves was qualified to sit in a normally energized position and wasn't tested for extended periods of de-energization per qualification report AQR-21678 & AQR-67368. Based on internal testing and industry operating experience, not all of our valves may exhibit de-energized prolonged period operational issues. This letter serves as a reasonable justification for valves other than the NP8321 series won't be affected by this operating condition.

NP8300, NP8314, & NP8320 series:

These valves are direct acting valves where all the power required to shift position of these valves is with the springs and solenoid power, no pressure assistance is required. The air pressure in the valve provides negligible amounts of force and resistance on these valves. Combined with known operating experience therefore we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state.

NP8316 series:

This is an internally pilot operated valve where two diaphragm valves are controlled with an internal 8320 style pilot. Whether energized or de-energized, there is always a

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diaphragm with a pressure differential across it. In the de-energized position, inlet pressure is routed to the top of the inlet diaphragm closing the inlet diaphragm. When energized, the pressure on top of the diaphragm is routed to the cylinder port where it exhausts faster than it can be filled, opening the inlet diaphragm. At the same time inlet pressure is routed to the top of the exhaust diaphragm closing it. Combined with known operating experience therefore we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state. For proper operation of this valve, it requires a 10-psi minimum operating pressure differential between the inlet port and exhaust port to be maintained while the valve changes state. Full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

NP8321 series:

This valve is available in normally open and normally closed operation. When the valve is in a normally closed configuration, in the de-energized state the u-cup is pressurized while in the energized state the u-cup isn't pressurized. In the normally open configuration this is reversed. Due to operating experience at lower pressures, this U-cup being left in a persistent pressurized state has shown to have increase fiction leading to the valve shifting to a mid-position with all ports open to each other. In the de-energized position, the valve routes pressure to the U-cup, which is larger than the inlet seat, pushing a piston against the inlet seat, closing it. When the valve shifts to the energized position, the pressure on the u-cup is opened to the exhaust port, while the inlet pressure pops the piston assembly, after this initial movement the force moving the piston assembly is greatly reduced until it seals against the exhaust port. For applications where the U-cup is continuously pressurized, this can lead to increased friction from the U-cup, which can be higher than the traveling force on the piston, which opens all ports to each other.

At higher pressures above 80 psi there is no known operational issues and conservatively twice as high as any observed operation issues both at ASCO and known operating experience. It is our recommendation that valves operating with the U-cup consistently pressurized (de-energized for normally closed, energized for normally open) that the pressure differential between the inlet port and the exhaust port be maintained above 80 psi while the valve is changing states. Full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

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NP8321 testing clarification:

ASCO performed extensive testing on this valve with a variety of U-cups and found all U-cups used for the NP8321 series have some low pressure de-energized dormancy performance limitations. After 2018 we switched to an alternative previously approved U-cup supplier used on other NP series valves and we found that this U-cup experienced low pressure de-energized dormancy performance limitations below 40 PSI where the valve did not shift completely to an energized state. Previously used U-cups, alternative U-cups such as FKM and our Gamma+ u-cup performed better in the 20-25 PSI range, but none was able to work down to 15 psi minimum pressure differential. Because of this ASCO recommended an alternative NP8300 valve for this application. In the interim ASCO recommends increasing the inlet pressure to the valve to at least 80 psi to conservatively ensure proper operation of the NP8321 series valve in a de-energized state.

NP8342 series:

This valve is a direct acting valve and like the other direct acting valves the operation of the valve is entirely dependent of springs and the power of the solenoid coil. Unlike the other direct acting valves, this valve has internal U-cups and the amount of pressure on the valve has a direct effect on the amount of friction on the internal components that move. The higher the pressure the higher the internal friction on the sliding surfaces. The U-cups and the internal friction is the same regardless of if it energized or de-energized as these U-cups seal against the seats that control which port is exhausting. Since the valve was evaluated at its maximum pressure, the as tested qualification report is with this valve in its worst operational state. Combined with known operating experience therefore we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state.

NP8344 series:

This is an internally pilot operated valve where a piston is controlled with an internal 8320 style pilot. Whether energized or de-energized, there is always a U-cup on the piston with a pressure differential across it. In the De-energized position, a smaller U-cup has pressure on it, holding the seats in one position. When energized, a larger U-cup has pressure routed to it, which overpowers the smaller U-cup and moves the piston and shifts the seats to a different position. When de-energized this U-cup is exhausted, and the smaller U-cup moves the piston the other direction. The pressure on these U-cups is consistent throughout the travel of the piston, therefore there is no

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condition in which friction can be higher than the force on the u-cups except below 10 psi, regardless of if it's energized or de-energized.

Combined with known operating experience therefore we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state. For proper operation of this valve, it requires a 10-psi minimum operating pressure differential between the inlet port and exhaust port to be maintained while the valve changes state. Full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

Minimum operating pressure differential:

The NP8316, NP8321, & NP8344 series valves require a minimum operating pressure differential for the valve to properly operate. This minimum pressure differential is measured at the valve between the inlet pressure port and the exhaust port only. The pressure of the cylinder port can be fully open or fully blocked, the minimum operating pressure differential doesn't change. This minimum operating pressure differential must be maintained while the valve changes position, from de-energized to energized, or energized to de-energized. For installations where there is a large amount of volume on the cylinder port, or essentially fully open, when the valve first shifts position, there will be a large movement of air from the inlet port to the cylinder port, if there is insufficient volume in the inlet or a regulator that has a lower flow rate than the valve, then the pressure differential may drop below the minimum required and the valve may enter a mid-shift position where all ports are open to each other, meaning the inlet and cylinder power is open to the exhaust port.

Operating or test conditions where there are restrictions on the inlet from either insufficient volume and/or insufficient flow to the valve that can cause operational issues. It is also known that restrictions on the exhaust port can cause pressure to temporarily build up in the exhaust port while the valve is changing states, which causes the pressure differential to drop below the required minimum. ASCO recommends full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

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Conclusion:

ASCO concludes based on design and known operating experience that only the NP8321 valve has a known low pressure dormancy condition which could cause the valve to not operate properly when shifting to an energized position.

If you have any questions regarding this evaluation, please contact me at Bryan.Causey@Emerson.com or Nicholas.Ingles@Emerson.com.

Regards,

Bryan Causey
Quality Engineer

Nicholas Ingles
Nuclear Product Engineer

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4-21-2025

Ref: ASCO NP8321 series valves

Reported non-conformance:

A Series NP8321 valve was returned with an operating condition normally de-energized with about 40-45 PSI of air. It is periodically called upon to energize and shift to an energized position. The valve does not shift or partially shift after periods of extended de-energization.

ASCO qualification testing:

As recorded in Asco Qualification Reports AQS-21678/TR and AQR-67368, all NP-1 type solenoid valves including the NP8321 series were qualified while in the energized state for extended periods of time to simulate the worst-case thermal cycle for the designs. This testing precluded extended periods of the valves being in the de-energized state. Based on internal testing and known operating experience, only the NP8321 series may experience operational issues after extended periods of being in the de-energized state wherein operating pressure is below 80-90 psi. This letter serves as a reasonable justification for valves other than the NP8321 series won't be affected by this operating condition.

NP8300, NP8314, & NP8320 series:

These valves are direct acting valves where all the power required to shift position of these valves is with the springs and solenoid power, no pressure assistance is required. The air pressure in the valve provides negligible amounts of force and resistance on these valves. Combined with known operating experience, we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state.

NP8316 series:

This is an internally pilot operated valve where two diaphragm valves are controlled with an internal 8320 style pilot. Whether energized or de-energized, there is always a diaphragm with a pressure differential across it. In the de-energized position, inlet pressure is routed to the top of the inlet diaphragm closing the inlet diaphragm. When energized, the pressure on top of the diaphragm is routed to the cylinder port where it exhausts faster than it can be filled, opening the inlet diaphragm. At the same time inlet

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pressure is routed to the top of the exhaust diaphragm closing it. Combined with known operating experience, therefore we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state. For proper operation of this valve, it requires a 10-psi minimum operating pressure differential between the inlets port and exhaust port to be maintained while the valve changes state. Full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

NP8321 series:

This valve is available in normally open and normally closed operation. When the valve is normally closed configuration, in the de-energized state the u-cup is pressurized while in the energized state the u-cup isn't pressurized. In the normally open configuration this is reversed. Due to operating experience at lower pressures, this U-cup being left in a persistent pressurized state has shown to have increased fiction leading to the valve shifting to a mid-position with all ports open to each other. In the de-energized position, the valve routes pressure to the U-cup, which is larger than the inlet seat, pushing a piston against the inlet seat, closing it. When the valve shifts to the energized position, the pressure on the u-cup is opened to the exhaust port, while the inlet pressure pops the piston assembly, after this initial movement the force moving the piston assembly is greatly reduced until it seals against the exhaust port. For applications where the U-cup is continuously pressurized, this can lead to increased friction from the U-cup, which can be higher than the traveling force on the piston, which opens all ports to each other.

At higher pressures above 80 psi there are no known operational issues and conservatively twice as high as any observed operation issues both at ASCO and known operating experience. It is our recommendation that valves operate with the U-cup consistently pressurized (de-energized for normally closed, energized for normally open) that the pressure differential between the inlet port and the exhaust port be maintained above 80 psi while the valve is changing states. Full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

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NP8321 testing clarification:

ASCO performed extensive testing on this valve with a variety of U-cups and found all U-cups used for the NP8321 series have some low pressure de-energized dormancy performance limitations. After 2018 we switched to an alternative previously approved U-cup supplier used on other NP series valves and we found that this U-cup experienced low pressure de-energized dormancy performance limitations below 40 PSI where the valve did not shift completely to an energized state. Previously used U-cups, alternative U-cups such as FKM and our Gamma+ u-cup performed better in the 20-25 PSI range, but none was able to work down to 15 psi minimum pressure differential. Because of this ASCO recommended an alternative NP8300 valve for this application. In the interim ASCO recommends increasing the inlet pressure to the valve to at least 80 psi to conservatively ensure proper operation of the NP8321 series valve in a de-energized state.

NP8342 series:

This valve is a direct acting valve and like the other direct acting valves the operation of the valve is entirely dependent on springs and the power of the solenoid coil. Unlike the other direct acting valves, this valve has internal U-cups and the amount of pressure on the valve has a direct effect on the amount of friction on the internal components that move. The higher the pressure the higher the internal friction on the sliding surfaces. The U-cups and the internal friction are the same regardless of if they are energized or de-energized as these U-cups seal against the seats that control which port is exhausting. Since the valve was evaluated at its maximum pressure, the as tested qualification report is with this valve in its worst operational state. Combined with known operating experience, we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state.

NP8344 series:

This is an internally pilot operated valve where a piston is controlled with an internal 8320 style pilot. Whether energized or de-energized, there is always a U-cup on the piston with a differential across it. In the De-energized position, a smaller U-cup has pressure on it, holding the seats in one position. When energized, a larger U-cup has pressure routed to it, which overpowers the smaller U-cup and moves the piston and shifts the seats to a different position. When de-energized this U-cup is exhausted, and the smaller U-cup moves the piston the other direction. The pressure on these U-cups is consistent throughout the travel of the piston, therefore there is no

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condition in which friction can be higher than the force on the u-cups except below 10 psi, regardless of if it's energized or de-energized. Combined with known operating experience, we can reasonably conclude that this valve shouldn't have any problem operating in a persistent de-energized state. For proper operation of this valve, it requires a 10-psi minimum operating pressure differential between the inlet port and exhaust port to be maintained while the valve changes state. Full unrestricted piping should be used, with full open exhaust ports and
sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

Minimum operating pressure differential:

The NP8316, NP8321, & NP8344 series valves require a minimum operating pressure differential for the valve to properly operate. This minimum pressure differential is measured at the valve between the inlet pressure port and the exhaust port only. The pressure of the cylinder port can be fully open or fully blocked, the minimum operating pressure differential doesn't change. This minimum operating pressure differential must be maintained while the valve changes position, from de-energized to energized, or energized to de-energized. For installations where there is a large amount of volume on the cylinder port, or essentially fully open, when the valve first shifts position, there will be a large movement of air from the inlet port to the cylinder port, if there is insufficient volume in the inlet or a regulator that has a lower flow rate than the valve, then the pressure differential may drop below the minimum required and the valve may enter a mid-shift position where all ports are open to each other, meaning the inlet and cylinder power is open to the exhaust port.

Operating or test conditions where there are restrictions on the inlet from either insufficient volume and/or insufficient flow to the valve that can cause operational issues. It is also known that restrictions on the exhaust port can cause pressure to temporarily build up in the exhaust port while the valve is changing states, which causes the pressure differential to drop below the required minimum. ASCO recommends full unrestricted piping should be used, with full open exhaust ports and sufficient inlet pressure volume or a regulator with a flow rate higher than the valve should be used to maintain sufficient pressure.

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Conclusion:

ASCO concludes based on design and known operating experience that only the NP8321 valve has a known low pressure dormancy condition which could cause the valve to not operate properly when shifting to an energized position. ASCO L.P. cannot determine Part 21 applicability. Each end user needs to perform their own evaluation based on the information provided in this notification and their own operating experience.

If you have any questions regarding this evaluation, please contact me at Bryan.Causey@Emerson.com or Nicholas.Ingles@Emerson.com.

Regards,

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