Implementation Guidance for NCP
(See MD 10.158 for detailed implementation guidance.)

Go to Form

Initiation of Non-Concurrence

Section A

- Employee notifies intent to non-concur, non-concurs on the subject document, and completes Section A.
- NCP Forms should ideally be submitted within 1 week of the verbal notification of the intent to engage in the NCP.
- If document marking is necessary, add the appropriate header/footer using the arrow key and mark the text within the “Reasons for Non-Concurrence and Proposed Alternatives” section in accordance with applicable agency guidance.
- Employee includes the title and ADAMS accession number of the document being non-concurred on (not the ADAMS number for the NCP Form--which doesn't go into ADAMS until process is complete). Include "N/A" if the document is not in ADAMS (e.g., inspection report not in ADAMS yet or document that includes Safeguards Information (SGI) or allegation-related information).
- If more than one employee non-concurs, include the additional names in Section A.
- Employees may choose to attach a separate Word document to address reasons for the non-concurrence, potential impact on the mission, and proposed alternatives. The form should be annotated, “See attached document,” and the attached document should be marked appropriately (if necessary), labeled (“Section A - Reasons for Non-Concurrence and Proposed Alternatives”).

  Note that the best way to describe the potential impact on the NRC's mission is in the context of the strategic goals, objectives, and strategies identified in the NRC Strategic Plan. For example, the submitter may conclude that there is an increase in the risk of the release of significant amounts of radioactive material to the environment (see safety objective). The submitter may conclude that there is an increase in the risk of an inadvertent release of classified information (see security objective). The submitter may conclude that the agency is not conducting itself in accordance with the Principles of Good Regulation (independence, openness, efficiency, clarity, and reliability) and that it could impact the performance of our mission (see vision statement).
- Employee must request an NCP tracking number by completing Section A of the NCP Form, signing it, and e-mailing it (and any continuation pages) and a copy of the subject document if it is not in ADAMS to NCPPM.Resource@nrc.gov.
- The NCP PM screens the submittal to ensure it is appropriate for the NCP and is completed correctly and signed. The NCP PM dates the form and adds the NCP tracking number, scans Section A and any other continuation pages, and e-mails the NCP Form to the employee's immediate supervisor, document signer, the employee, and all others on concurrence.

Section B

- Employee's immediate supervisor reviews the non-concurrence and, if a written evaluation is requested (see Section A), includes comments for the NCP Approver and others to consider. Immediate supervisor may document that they have no comments.
- Regardless of whether a written evaluation is requested, the employee's immediate supervisor signs Section B indicating that they have reviewed the non-concurrence and e-mails it to all others on concurrence, and NCPPM.Resource@nrc.gov.

Review of Non-Concurrence

Section C

- NCP Approver is responsible for reviewing the non-concurrence prior to the subject document being issued. NCP Approver is normally the document signer unless the document signer is not an SES manager or if the document signer is the individual's immediate supervisor, in which case the document signer should forward the NCP Form to the appropriate SES manager. Document signer continues to sign the subject document and the NCP Approver is added to the subject document concurrence. Lead office director is the NCP Approver if the EDO is the document signer.

Implementation Guidance for NCP
(See MD 10.158 for detailed implementation guidance.) (Continued)

Go to Form

- NCP Approver identifies the NCP Coordinator and forwards Sections A and B of the NCP Form to coordinate and document the evaluation and outcome in Section C. NCP Approver may choose to act as the NCP Coordinator.

- NCP Coordinator ensures that the non-concurring employee is included in discussions, when warranted, to maximize understanding and improve decisionmaking.

- If a written evaluation is requested, the NCP Coordinator documents the Summary of Issues (SOI) and e-mails it to the non-concurring employee for comment and consensus. Non-concurring employee reviews and responds to the SOI. The SOI ensures a common understanding of the issues and should be agreed upon before the NCP Form is evaluated by staff.

- NCP Coordinator completes Section C to reflect the review of issues and actions (if applicable) that were taken to address concerns, and the rationale for the outcome. Documentation should be complete, factual, and focused on the issues (not individuals) and should note any issues that were resolved to the employee's satisfaction. The level of detail must be sufficient so that an independent reader can understand the basis for the decision and outcome. If no action is taken, the reason(s) should be recorded on the form.

- NCP Coordinator ensures that the NCP Form is e-mailed to all employees on concurrence to support informed decisionmaking.

Final Review and Approval of Non-Concurrence

- NCP Approver reviews the NCP Form, may discuss with interested parties (including non-concurring employee), and may return NCP Form and subject document for additional action prior to signing Section C and prior to issuance of the subject document.

- Regardless of whether a written evaluation is requested, the NCP Approver signs Section C indicating that they have reviewed the non-concurrence prior to issuance of the subject document.

NCP Outcome and Record-Keeping

- After the process is complete and the subject document is signed, the NCP Coordinator completes the NCP cover page, including the outcome. If the non-concurring employee agrees with some changes made to the subject document, but still non-concurs, the NCP Coordinator should only check that box that applies.

- NCP Coordinator verifies whether the non-concurring employee wants the NCP Form public or non-public by checking the appropriate box. If the employee wants the NCP Form non-public, check the box on the NCP Form cover page that says **"This record is non-public and for official use only."**

- If the employee wants management to determine whether public release of the NCP Form (with or without redactions) is appropriate, the NCP Approver (with assistance from the NCP Coordinator) is responsible for performing a releasability review in accordance with "Releasability Review of NCP Forms" on the NCP Web site. If the NCP Approver determines that the NCP Form is appropriate for public release (with or without redactions), the NCP Coordinator checks the box on the NCP Form cover page that says **"This record has been reviewed and approved for public dissemination."**

- NCP Form (cover page and Sections A, B, and C) should be profiled in ADAMS using ADAMS Template NRC-006 (ML063120159), included in a package with the subject document, and filed in the NCP Forms folder in the ADAMS Main Library.

- NCP Coordinator will e-mail the completed NCP Form (ADAMS accession number) to NCPPM.Resource@nrc.gov.

- NCP PM will review the NCP Form for implementation completeness and post the NCP Form and issued subject document on the internal Web site.

NON-CONCURRENCE PROCESS COVER PAGE

Go to Instructions

The U.S. Nuclear Regulatory Commission (NRC) strives to establish and maintain an environment that encourages all employees to promptly raise concerns and differing views without fear of reprisal and to promote methods for raising concerns that will enhance a strong safety culture and support the agency's mission.

Employees are expected to discuss their views and concerns with their immediate supervisors on a regular, ongoing basis. If informal discussions do not resolve concerns, employees have various mechanisms for expressing and having their concerns and differing views heard and considered by management.

Management Directive, MD 10.158, “NRC Non-Concurrence Process,” describes the Non-Concurrence Process (NCP).

The NCP allows employees to document their differing views and concerns early in the decisionmaking process, have them responded to (if requested), and include them with proposed documents moving through the management approval chain to support the decisionmaking process.

NRC Form 757, “Non-Concurrence Process," is used to document the process.

Section A of the form includes the personal opinions, views, and concerns of a non-concurring NRC employee.

Section B of the form includes the personal opinions and views of the non-concurring employee's immediate supervisor.

Section C of the form includes the agency's evaluation of the concerns and the agency's final position and outcome.

NOTE: Content in Sections A and B reflects personal opinions and views and does not represent the official agency's position of the issues, nor official rationale for the agency decision. Section C includes the agency's official position on the facts, issues, and rationale for the final decision.

1. If the process was discontinued, please indicate the reason (and skip to #3):

- ☐ Non-concurring employee(s) requested that the process be discontinued
- ☐ Subject document was withdrawn

2. At the completion of the process, the non-concurring employee(s):

- ☐ Concurred
- ☑ Continued to non-concur
- ☐ Agreed with some of the changes to the subject document, but continued to non-concur

3. For record keeping purposes:

- ☐ This record is non-public and for official use only
- ☑ This record has been reviewed and approved for public dissemination

NRC FORM 757 (06-2019)
NRC MD 10.156

U.S. NUCLEAR REGULATORY COMMISSION

NON-CONCURRENCE PROCESS (Continued)

1. NCP Tracking Number
NCP-2020-006

Date
07/06/2020

Section A - To Be Completed By Non-Concurring Employee

2. Title of Subject Document PHASE 4-NuScale DC SER with No Open Items Chapter 15 PHASE 4-NuScale DC SER with No Open Items Chapter 6	**3. ADAMS Accession Number** ML19171A301/ML19170A112
4. Document Signer Joseph Donoghue	**5. Document Signer's Phone Number** (Enter 10 numeric digits) (301) 415-1193
6. Title of Document Signer Director, Division of Safety Systems	**7. Office** (Choose from the drop down list or fill in) NRR
8. Name of Non-Concurring Employee(s) Shanlai Lu	**9. Employee's Telephone Number** (Enter 10 numeric digits) (301) 415-2869
10. Title of Non-Concurring Employee Sr. Nuclear Engineer	**11. Office** (Choose from the drop down list or fill in) NRR

12. ☐ **Document Author** ☑ **Document Contributor** ☐ **Document Reviewer** ☐ **On Concurrence**

13. Name of Non-Concurring Employee's Supervisor Rebecca Patton	**14. Office** (Choose from the drop down list or fill in) NRR
15. Title of Non-Concurring Employee's Supervisor Branch Chief	**16. Supervisor's Telephone Number** (Enter 10 numeric digits) (301) 415-7533

17. ☑ **I would like my non-concurrence considered and would like a written evaluation in Section B and C.**

☐ **I would like my non-concurrence considered, but a written evaluation in Sections B and C is not necessary.**

18. When the process is complete, I would like management to determine whether public release of the NCP Form (with or without redactions) is appropriate (Select "No" if you would like the NCP Form to be non-public):

☑ **Yes** ☐ **No**

19. Reasons for the Non-Concurrence, Potential Impact on Mission, and the Proposed Alternatives

The details are documented in the attached report.
The following are the summary:

Section 15.0.0.6.3 and 15.0.0.6.4

-- Missed the classification of events involving non-safety injection systems.

Section 15.0.5

-- Used a non-conservative volatility correlation and non-application boiling length test data
-- Missed the analysis of adverse impact of n non-safety injection systems.

Section 15.6.5

--As the result of Section 15.0.5, long term cooling conclusion is no longer valid.

Section 6.3 ECCS Design

--As the result of Chapter 15 deficiencies, ECCS design is incomplete.

NON-CONCURRENCE PROCESS (Continued)

20. Signature and Date of Non-Concurring Employee

Shanlai Lu

Digitally signed by Shanlai Lu
Date: 2020.07.02 15:41:56 -04'00'

NON-CONCURRENCE PROCESS (Continued)

1. NCP Tracking Number
NCP-2020-006

Date
07/06/2020

Section B - To Be Completed By Non-Concurring Employee's Supervisor

2. Title of Subject Document
PHASE 4-NuScale DC SER with No Open Items Chapter 15
PHASE 4-NuScale DC SER with No Open Items Chapter 6

3. ADAMS Accession Number
ML19171A301/ML19170A112

4. Name of Non-Concurring Employee's Supervisor
Rebecca Patton

5. Office (Choose from the drop down list or fill in)
NRR

6. Title of Non-Concurring Employee's Supervisor
Branch Chief

7. Supervisor's Telephone Number (Enter 10 numeric digits)
(301) 415-7533

8. Comments for the NCP Reviewer to Consider
See attached

9. Signature and Date of Non-Concurring Employee's Supervisor
Rebecca L. Karas
Digitally signed by Rebecca L. Karas
Date: 2020.07.24 11:45:45 -04'00'

Section C - To Be Completed By NCP Coordinator

2. Title of Subject Document	3. ADAMS Accession Number
PHASE 4-NuScale DC SER with No Open Items Chapter 15 PHASE 4-NuScale DC SER with No Open Items Chapter 6	ML19171A301/ML19170A112

4. Name of NCP Coordinator	5. Office (Choose from the drop down list or fill in)
Jason Thompson	RES
6. Title of NCP Coordinator	**7. Coordinator's Telephone Number** (Enter 10 numeric digits)
Reactor Systems Engineer	(301) 415-1660

8. Agreed Upon Summary of Issues

1. Phenomenon Identification and Ranking Table (PIRT);
   NuScale's 2008 overall PIRT approach missed the interrelated parts of the design and analyses associated with the boron dilution phenomenon for anticipated operational occurrences (AOOs), design basis accidents, and beyond design basis accidents. Therefore, there could be dilution mechanisms not evaluated by NuScale, such as the actuation of non-safety grade injection systems during post-Emergency Core Cooling System (ECCS) operation or manometer type flow oscillations under low pressure and temperature.

2. System Vulnerability and Sensitivity to System Disturbances;
   Over time, the system becomes vulnerable to any disturbance following ECCS operation due to the presence of a large volume of diluted fluid in the downcomer and lower plenum that can be transported into the core through non-safety system injection, manometer oscillations or flow instability.

3. Event Trees and Events Involving System Disturbances;
   The event classification in the Design Certification Application (DCA) and Safety Evaluation Report (SER) Section 15.0.0.6.3 and 15.0.0.6.4 missed inclusion of non-safety injection system operation (Chemical Volume Control System (CVCS) injection through spray or riser injection; or Containment Flooding and Drain System (CFDS) injection) during the progression of postulated accidents (PAs) and AOOs.

   NuScale identified use of CVCS to respond to small leakage events. It was the availability of CVCS that motivated staff to relax acceptance criteria for leakage events below the loss of coolant accident (LOCA) spectrum and recommend approval of the General Design Criteria (GDC) 33 exemption, even though confirmatory analysis showed the riser holes could become uncovered. If the operation of CVCS could be part of the event progression or credited by NuScale, then it should be evaluated in the analysis of these events, including the adverse impact on ECCS performance.

4. Design Basis Events and Long-Term Cooling Without Non-safety System Operations;
   (A)According to NuScale's response to Request for Additional Information (RAI) 8930, several hours after ECCS operation, most of the boron has migrated to the core and lower riser, and the boron concentration is close to zero in the downcomer, lower plenum and the volume above the reactor recirculation valves (RRVs) in containment. NuScale assumed [[ ]], and therefore concluded there was no dilution in the core. The [[ ]] assumption is non-conservative. The non-concurring individual performed an analysis assuming 95% of the borated fluid returns to the core. With that assumption the reactor would return to criticality after 9 hours with one stuck rod, and 20 hours with all rods in.
   (B)NuScale responded to the concern about the [[ ]] assumption by using test data from VEERA to show that there is a lower boron concentration below the boiling length. There are a variety of concerns relating to inapplicability of the boiling length shown by VEERA since the NuScale reactor has different dimensions and fluid volume configurations. Use of the VEERA data to determine the non-boiling length in the NuScale reactor is therefore non-conservative.

(C) The German volatility correlation (Böhlke) is not scalable to the NuScale design, based on its data being collected at the BORAN facility with very different heated lengths and mass flow rates. In addition, the correlation predicts a lower value for volatility by a factor of 2 compared to WAPD data and data published in the 1999 Chemical Thermodynamic Journal. Staff performed sensitivity analyses that showed a return to power within 72 hours once other volatility correlations are used.
(D)Although there are other conservatisms in the methodology, both the non-boiling length determination and the volatility correlation are major uncertainties, and therefore the overall conservatism of the approach cannot be proven. As such, there is no reasonable assurance that there will not be a return to power with boron in the reactor coolant system (RCS) during the post ECCS operation boron dilution process.

5. Design Basis Events and Long-Term Cooling with Non-safety System Operations;
Preliminary confirmatory calculations were performed for a CVCS line break with initiation of various non-safety injection scenarios 1 hour after ECCS operation commenced, resulting in a surge of colder water into the core. Although only 1 hour post ECCS operation is not long enough to cause significant boron dilution in the downcomer, the analyses were performed to study characteristic thermal-hydraulic behavior of this reactor. The initial results of non-safety injection at 1 hour after ECCS operation are listed below:

(A)Injection via pressurizer sprays could result in $21 of reactivity over 60 seconds, which could lead to core failure.
(B)For injection via CFDS, $21 would be injected into the core over 15 minutes, which would return the core to power with all rods in and has not been analyzed.
(C)For injection via CVCS into the riser, a RES hand calculation demonstrates a surge will enter the core, and an NRELAP5 calculation shows significant manometric oscillations with a return to power with or without a stuck rod. Additional studies are needed.

These scenarios can be so severe that core damage is expected. These scenarios have not been analyzed by NuScale as part of long-term cooling. The core damage frequency (CDF) could be in the range of 3.3e-5 to 3.3e-7.

6. Beyond Design Basis Events and Shutdown Operation.

Chapter 19 event trees and sequences did not account for either adverse non-safety system operation or boron dilution, and consideration of these would change the overall risk profile. NuScale has claimed non-safety system operation should be part of post-ECCS recovery operation governed by Emergency Operating Procedures (EOPs) developed by Combined License (COL) applicants. However, NuScale requested relaxation of requirements for small leakage events in its GDC 33 exemption and claimed the operator can take action to mitigate the boron dilution, which is inconsistent with the prior statement. If a recovery scenario can result in a return to power with all rods in, it should be treated as an extension of the AOO or PA and evaluated in Chapter 15. It is also important to note that GDC 27 exemption does not permit a return to power with all rods in. Early in core life, these scenarios can result in core damage, and there may not be a reasonable recovery capability.

In 2018, the non-concurring individual also identified a passive boron injection system which could be added, reviewed and approved within the current design certification schedule.

9. Evaluation of Non-Concurrence and Rationale for Decision

I appreciate the willingness of staff to raise differing views as I believe the dialogue that occurs supports a thorough safety evaluation, as I observed in the NuScale safety evaluation report (SER). Further, I appreciate that Dr. Lu contributed significant effort in raising his issues and has worked diligently to communicate his concerns. I also appreciate the comments provided by the non-concurring employee's supervisor in Section B of this form.

Dr. Lu and his supervisor have had significant engagement on the issues in the Summary of Issues (SOI) during the course of the review. I also had the benefit to discuss Dr. Lu's concerns with him and other staff during the review. In addition, Dr. Lu presented his concerns to the Advisory Committee on Reactor Safeguards (ACRS) during the 675th ACRS meeting on July 8, 2020. These frequent and open interactions have been vital to effectively accomplishing our mission.

The supervisor's evaluation in Section B provides a thorough response to each of the technical issues in the SOI (and Section A). I concur with that evaluation, and the information in Section B forms a significant basis for the rationale in my decision. Most of the information in Section B is not repeated here, and readers are encouraged to refer to that section for an itemized response to the SOI. In addition to the information in Section B, my evaluation of the non-concurrence was based on (1) the Chapter 15 SER and (2) deliberations at the 675th and 676th ACRS meetings and associated documents, which focused on boron redistribution in the NuScale Power Module. I also evaluated the issues Dr. Lu identified with respect to beyond design basis accident analyses considered in Chapter 19 of the SER. These issues are listed in the SOI and directly addressed in Section B. Dr. Lu's concerns were shared with staff and management responsible for the Chapter 19 SER, and their input was used in this evaluation.

Chapter 15 SER

The staff review was conducted within the framework of applicable regulations and guidance. Specifically, for the issues considered here, the applicable regulations and guidance include the General Design Criteria in 10 CFR Part 50, the Standard Review Plan, and the Design Specific Review Standard Sections for Chapter 15. Consistent with the applicable regulations and guidance and as documented in SER Section 15.0.0.6, the applicant did not credit operator actions in mitigating Chapter 15 design basis events for at least 72 hours. Further, the applicant credited neither Chemical Volume Control System (CVCS) nor Containment Flooding and Drain System (CFDS) to mitigate design basis events.

In conducting its review, the staff relied upon information provided by the applicant, including extensive analyses of events and phenomena that would affect boron distribution and the potential for a return to power. The staff engaged in extensive audit activities to review design information and the applicant's analyses. Additionally, the staff conducted numerous confirmatory calculations to support the conclusions in the safety evaluation.

The staff's evaluation of the riser hole design to preclude a diluted downcomer, potentially causing a return to power upon Emergency Core Cooling System (ECCS) actuation with an uncovered riser, is provided in SER Section 15.0.5. In SER Section 15.0.6, the staff documented their review of the applicant's justification (ML19332A120) that the core reactivity would not be adversely affected by boron redistribution to locations outside the core, and therefore, would not return to power as a result. The complete and itemized response to each of the associated issues in the SOI is provided in Section B. I found that the staff performed a complete and thorough review, and I found their weighting of conservatisms and uncertainties particularly compelling.

In Section 15.6.5, “Long-Term Cooling after a Loss-of-Coolant Accident,” the staff determined that the regulatory requirements for post-LOCA long-term cooling were met when the reactor is maintained in a subcritical state throughout the 72-hour ECCS cooldown. The staff determined that the analysis of long-term cooling resulting from LOCA events contain ample margin to the acceptance criteria.

I accept that the staff's documented review, including consideration of specific important phenomena, the conservativism of key assumptions, the extensive audit of applicant analyses and confirmatory analyses conducted by the staff, support the conclusion of reasonable assurance of safety for this design.

ACRS Considerations

I also considered deliberations at ACRS meetings and associated documents while evaluating the non-concurrence. During the 675th and 676th ACRS meetings, staff presented their safety finding related to most of the issues in the

SOI. The staff position on these issues are well characterized in Section B of this form.

Staff provided supplemental information to ACRS for the 675th meeting that included a systematic review of potential reactivity insertion mechanisms (ML20191A069), and ACRS thoroughly considered the potential mechanisms of concern. Mechanisms affecting core reactivity are also addressed in the staff's SER, and I am therefore confident that the phenomena that could challenge safety have been appropriately considered. During the 675th meeting, I also had the benefit of Dr. Lu's presentation of his technical concerns to the Committee and attending staff.

During the 676th ACRS meeting, staff provided additional supplemental information related to event classification. Staff summarized that any post-event thermal-hydraulic disruption to the reactor coolant system that would potentially impact the specified acceptable fuel design limits (SAFDLs) would require multiple failures or operator errors of commission, which is beyond the scope of the Chapter 15 transient analysis. I agree with this conclusion, and these events are discussed in greater detail below and in Section B.

In addition, the staff provided supplemental information related to boron mixing in the core during long-term cooling in the context of beyond design basis events. The staff identified a series of separate effects and integral effects tests that demonstrate the internal recirculation phenomenon. The tests have shown: (1) voiding even under adiabatic conditions drives internal recirculation, (2) the effect of radial power distribution to enhance the internal recirculation effect, and (3) how internal recirculation homogenizes the axial and radial boron distribution (ML20183A149). These tests provide supporting evidence that the boron within the core and riser will be well mixed. These analyses were not credited in the Chapter 15 SER.

Beyond Design Basis Accident Analyses

Postulated events with multiple deleterious operator actions are outside the scope of the design basis events (i.e., Chapter 15), and are instead evaluated in Chapter 19 as beyond design basis events. The events identified in the fifth issue of the SOI are evaluated in Chapter 19 for this reason. For example, for the CVCS injection case, the containment will automatically isolate during the conditions necessary to significantly deborate the fluid in the downcomer, and multiple deliberate operator actions are required to override containment isolation and initiate CVCS injection. Similar reasoning applies for CFDS injection.

Staff evaluated the sequence of events for the worst case small break loss of coolant accident (SBLOCA) with failure to scram to determine which conditions and phenomena could produce the potential for a core flow surge to yield core damage as a result of a super prompt reactivity excursion (ML20191A069). Within these analyses, staff conducted a systematic review of potential reactivity insertion mechanisms, including non-safety injection. Staff and management responsible for the Chapter 19 SER reviewed and concurred with these analyses, concluding that the physical conditions and operator actions necessary to cause core damage are unlikely. Additional details are provided in Section B and the staff's Chapter 19 SER. I concur with the staff's classification of postulated events with multiple deleterious operator actions. Further, I am confident the responsible staff have appropriately considered these events in their safety evaluation.

Conclusion

Dr. Lu raises valid technical concerns with respect to the behavior of the NuScale Power module. The concentration of boron in the coolant and the resulting impact on reactor criticality is an important consideration documented in the staff's safety evaluation and Dr. Lu's focus on this area is understandable. In its safety evaluation, the staff directed significant attention to understanding aspects of the unique design and its response to disturbances that could challenge safety. I found the staff's evaluation of these issues to have been thorough and sufficient to support a conclusion of reasonable assurance of safety.

I accept the conclusions reached by the staff and documented in the safety evaluation that are based on extensive

audit of applicant's analyses of important phenomena, and staff confirmatory calculations that demonstrate that the applicable regulations and guidance are satisfied.

I again want to acknowledge the significant effort that Dr. Lu devoted in raising his issues and the professional manner and diligence in which he communicated his concerns. I also appreciate the consideration given by the non-concurring employee's supervisor.

10. Signature and Date of NCP Coordinator

Jason C. Thompson

Digitally signed by Jason C. Thompson
Date: 2020.08.06 08:28:03 -04'00'

11. Signature and Date of NCP Approver

Joseph E. Donoghue

Digitally signed by Joseph E. Donoghue
Date: 2020.08.13 13:44:25 -04'00'