Paragon

Date: 12/15/2025

To: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555
Fax Number (301) 816-5151

10CFR Part 21 Final Notification: P21-10112025-FN, Rev. 0

Subject: Positive Post Corrosion Failures in Stryten (formerly GNB) N&M Series Flooded Batteries Installed in 24VDC, 48VDC, 125VDC and 250VDC Station Battery Strings

Pursuant to §10CFR 21.21(d)(3)(ii), Paragon is providing final notification of a condition which can potentially cause premature failure of positive posts in Stryten (formerly GNB) N&M Series Flooded Batteries.

The following information is required per §10CFR 21.21 (d) (4).

(i) Name and address of the individual or individuals informing the Commission.

Richard Knott, Vice President Quality Assurance
Paragon Energy Solutions, LLC
7410 Pebble Drive
Ft. Worth, TX 76118

(ii) Identification of the facility, activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.

See attached list of Licensees utilizing the affected battery models.

(iii) Identification of the firm constructing or supplying the basic component which fails to comply or contains a defect.

The batteries were originally supplied by:

Paragon Energy Solutions, LLC (Formerly Nuclear Logistics Inc.)
7410 Pebble Drive
Fort Worth Texas, 76118

(iv) Nature of defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

Paragon received reports of failures of individual battery cell positive posts on Stryten (GNB) NCN model flooded lead acid batteries. NCN, NCX and MCX models are susceptible to this failure mode. The post failures have been attributed to nodular corrosion which caused the posts to fracture in the post seal threaded region, and in extreme cases resulted in arcing or a localized fire at the cell post during the initiation of a service test discharge. This failure mode has the potential to cause the station battery string voltage output to fluctuate or to drop to 0 VDC, interrupting power to critical safety related equipment. This condition could cause a safety hazard depending on the specific installation arrangement at the plant.

(v) The date on which the information of such defect or failure to comply was obtained.

On 10/9/2025, Paragon claimed discovery of the condition; however, the specific deviation or failure to comply was not understood. Out of an abundance of caution, Paragon submitted our initial report of this condition on 10/11/2025 to allow affected Licensees the opportunity to evaluate their battery installations for indications of this condition. A follow up interim notification was submitted on 10/31/2025 due to needing additional time to complete the failure analysis.

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of these components in use at, supplied for being supplied for, or may be supplied for, manufactured or being manufactured for one or more facilities or activities subject to the regulations in this part.

See attached list of Licensees utilizing the affected battery models.

(vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that has been or will be taken to complete the action.

Paragon entered this issue into our Corrective Action Program and has conducted an extensive failure analysis of returned failed cells from Constellation Quad Cities Clean Energy Center. Paragon was unable to identify the specific defect or failure to comply with the post seal design which if corrected would prevent this condition from occurring. However, we have identified several contributing causes which together could contribute to the premature failures experienced:

The Lead-Calcium-Tin post material in the presence of electrolyte (Sulfuric Acid H_2SO_4) and stress allows nodules of Lead Sulphate ($PbSO_4$) crystals to form in micro cracks in the post seal area. Once the nodules form, the corrosion can propagate over time and result in post fracture. The initial micro cracks form over several years due to creep of the lead material which can occur due to the stress placed on the threaded area by the torque applied to the seal nut.

Paragon's review of the manufacturing process identified the tooling used in post seal nut tightening could cause inconsistent application of torque sometimes exceeding the design torque specified. Creep can occur in the lead material of the positive post at the normal battery room temperatures. The creep rate increases with elevated stress and temperature. Migration of electrolyte into the post seal area is expected to occur over the lifetime of the battery due to normal electrochemical processes. The gasket seal only mitigates the migration rate such that the battery can achieve its service life.

Based on the failure analysis conducted, the following corrective actions have been or are being taken to ensure post seal integrity is not compromised and inspection for the onset of corrosion can be completed to allow early correction before failure:

1) Paragon will establish improved controls to ensure assembly of the post seal per the design. **(Paragon Engineering ECD 12/31/2025)**

    a. Paragon SVP-31 *STANDARD VERIFICATION PLAN STRYTEN ENERGY SAFETY RELATED NC & MC SERIES BATTERIES* will be revised to ensure Paragon inspectors verify the seal assembly components are installed using hand tools only and verified to be torqued to the design value using calibrated torque wrenches on 100% of batteries supplied.

    b. Awareness briefings regarding the desired method for post seal nut tightening for both Paragon and Stryten engineering, technician, and quality inspection teams will be conducted.

2) Paragon will issue a revised Instruction and Operation Manual (IOM) recommending enhanced monthly and annual visual inspection criteria and processes augmenting those detailed in IEEE 450:2020 IEEE *Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications* and NRC Regulatory Guide 1.129 Rev 4 *Maintenance, Testing, and Replacement of Vented Lead-Acid Storage batteries for Production and Utilization Facilities*. This will allow for early detection and corrective action for this condition for in-service batteries. **(Paragon Engineering ECD 02/16/2026)**

(viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

Based on the analysis, the observed failure mode takes several years to advance to the point of failure. Operating experience reviewed shows this failure mode has not occurred in Stryten batteries less than 10 years old from the time of shipment. For in-service batteries, the following recommended inspections enable the Licensees to identify suspect cells and allow for corrective action prior to reaching the point of individual cell failure such that the battery system will perform for the intended service life.

For In-service Batteries: (See attached pictures for examples of the conditions below)

a. Indication of nodular corrosion is often visible in advanced stages. Jar cover cracks, post blackening, bulging or cracking of the post seal nut (figures 1 through 4), and cracking of the post penetration boss under the surface of the cover (figure 5) are indications of nodular corrosion. Paragon recommends licensees perform a visual inspection of their batteries for nodular corrosion. Use of a flashlight and borescope (for full internal inspection of the positive post seal boss area) is recommended while employing appropriate safety precautions. The inspection requirements and safety precautions will be provided in the revised Instruction and Operation Manual (IOM).

b. While performing visual inspections of the battery room, identify conditions that could add unnecessary stress to the cell positive posts such as:

   - Verify intercell cabling is properly supported such that the weight of the cables is not supported by the post alone (figure 6).

   - Verify alignment of intercell connector plates and cells. The cells should be flush with one another accounting for the appropriate spacing (approx. ½ inch) between cells and nominally parallel and equidistant to the rack rails (figure 7).

c. During individual cell float voltage measurements (per Manufacturers Instruction Manual and IEEE-450), if abnormally high float cell voltage is measured, Paragon recommends the condition be evaluated in accordance with IEEE 450:2020 C.3.2 to determine if compromised cell post integrity is contributing to the abnormal measurement.

Additionally, it is recommended that Licensees maintain battery room temperatures in accordance with the Manufacturers Instruction Manual. For maximum service life and to aid in the mitigation of creep corrosion, extended periods of battery room temperature above 77°F should be minimized as practical.

Documented cell deficiencies and anomalies, along with pictures, are requested to be sent to Paragon at Batteries@Paragones.com. Paragon can assist the station with inspection and evaluation of the conditions of the batteries. For emergent issues please call 865-888-6853.

Sincerely,

Richard Knott
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Paragon Energy Solutions LLC
817-284-0077
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List of Licensees Utilizing Affected Battery Models

Paragon has supplied Class 1E and/or commercial grade batteries to the plants identified below. All installations are GNB/Stryten batteries/cells supplied under the Paragon Quality Assurance Program since 2005. It is recommended that plants also consider installations of M and N Series batteries that have been approved for service life extension beyond the 20-year qualified life recommendation or supplied by alternate suppliers.

Site	Battery/Cell Model
Ameren	
Callaway	NCN-13S, NCN-23S
Arizona Public Service (APS)	
Palo Verde	NCN-33, NCN-33S
Constellation	
Calvert Cliffs	NCN-15, NCN-21, NCN-21S, NCN-27
Dresden	2-MCX-5, NCN-21, NCN-21S, NCN-27
Fitzpatrick	NCN-35
Ginna	NCN-21
LaSalle	NCN-17, NCN-17S, NCN-27, NCN-27S, 2-MCX-5
Nine Mile Point	NCN-35, NCN-35S
Quad Cities	2-MCX-5, NCN-21, NCN-21S, 2-MCX-05, MCX-05
Dominion	
Millstone	NCN-11S, NCN-27, NCN-27S, NCN-35, NCN-35S, NCX-35
NextEra Energy	
Seabrook	NCN-35S
Duke	
Brunswick	NCX-9S, NCN-17, NCN-17S
Carolina Power & Light	NCN-17
Catawba	NCN-9, NCN-21, NCN-27
H.B. Robinson	NCN-15
McGuire	NCN-27
Oconee	NCN-27S
Entergy	
River Bend	NCN-29S, NCN-29S, NCX-35S
Florida Power & Light (FPL)	
Turkey Point	NCN-17, NCN-17S, NCN-25, NCN-25S, NCN-27, NCN-27S
Vistra	
Beaver Valley	NCX-29S, NCX-33S, NCX-35S
Comanche Peak	NCN-17, NCN-17S, NCN-27, NCN-27S
Davis Besse	NCN-21, NCN-21S
South Texas Nuclear Operating Company (STPNOC)	

Site	Battery/Cell Model
South Texas Project	NCN-17, NCN-17S, NCN-27
Bruce Power	
Bruce Power	MCX-09S, MCX-13S, NCN-27, NCN-27S, NCN-35, NCN-35S
Siemens/Bruce Power	MCX-13, NCN-27
KHNP	
Hanbit	NCN-11S, NCN-33S
Kori	NCN-11S, NCX-17S, NCN-21S, NCN-25, NCX-27, NCX-31, NCX-31S, NCN-33S, NCX-35
OPG	
OPG	NCN-23

Note: The “S” suffix is an administrative designator only. The design and manufacturing of cells with or without the “S” is the same.

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Visual Inspection Conditions Requiring Further Evaluation

During battery system visual inspection, attention should be given to the following conditions.
Positive Post Corrosion Indications – Figures 1 thru 4 below provide visual indicators of corrosion in the post seal area.

Figure 1

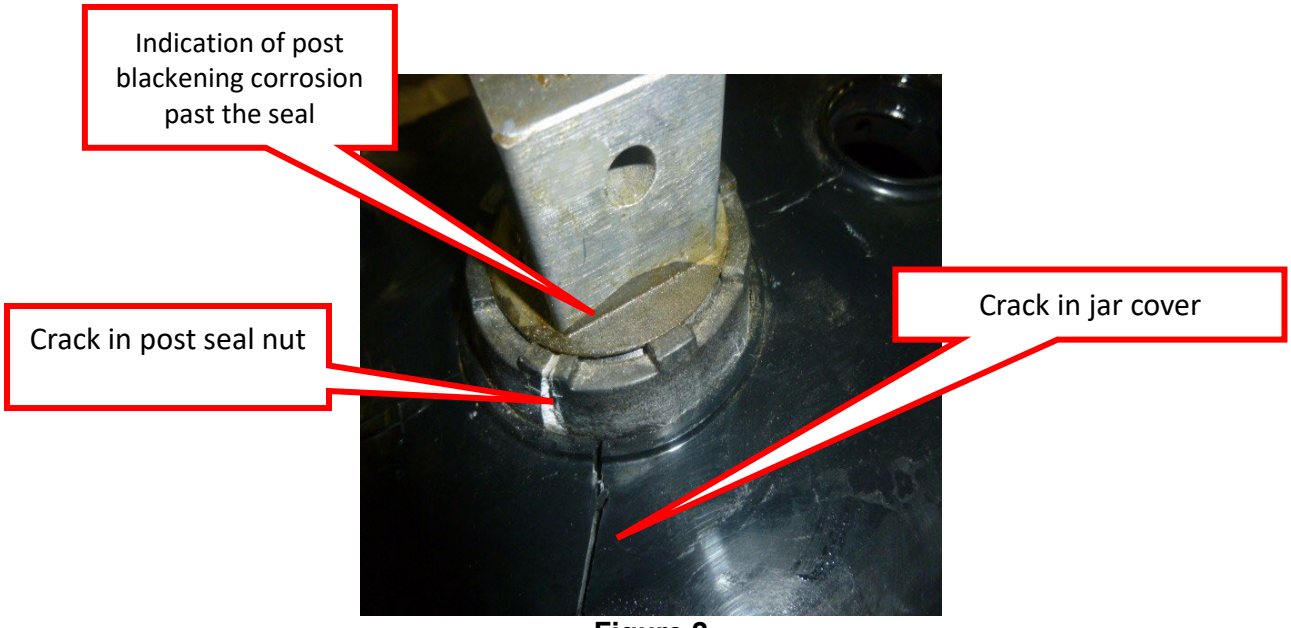

Figure 2

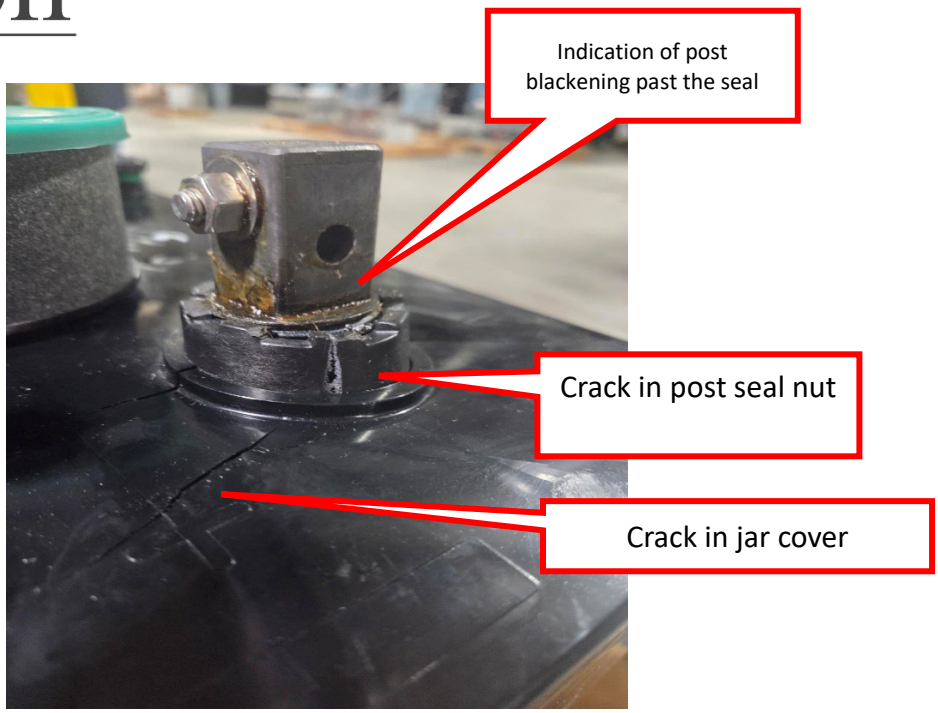

Figure 3

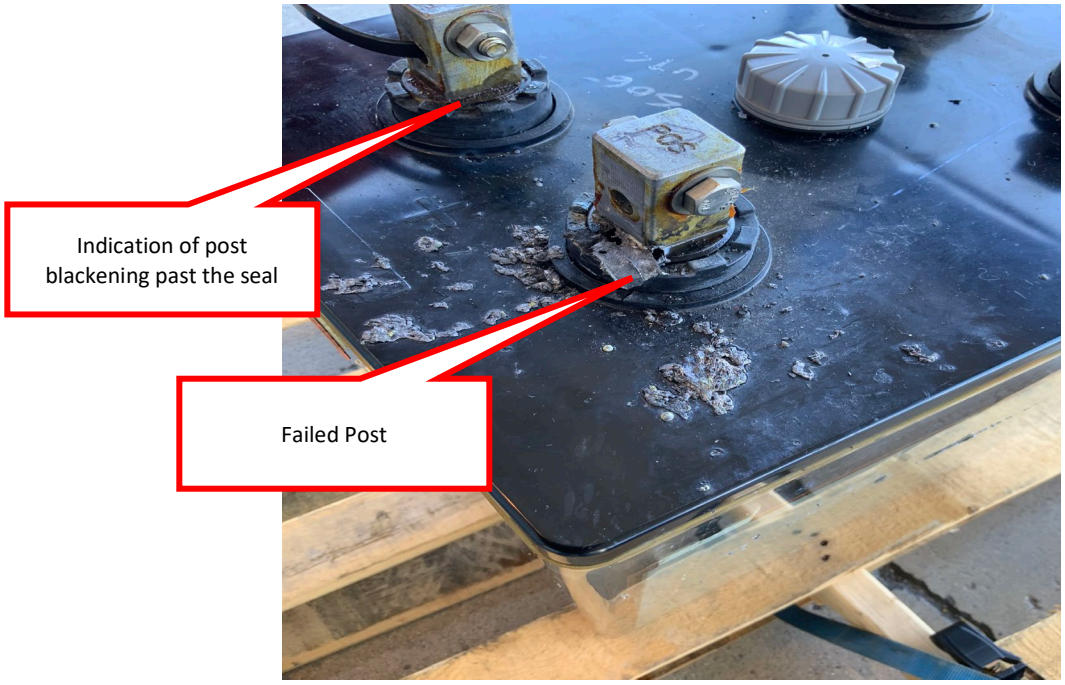

Figure 4

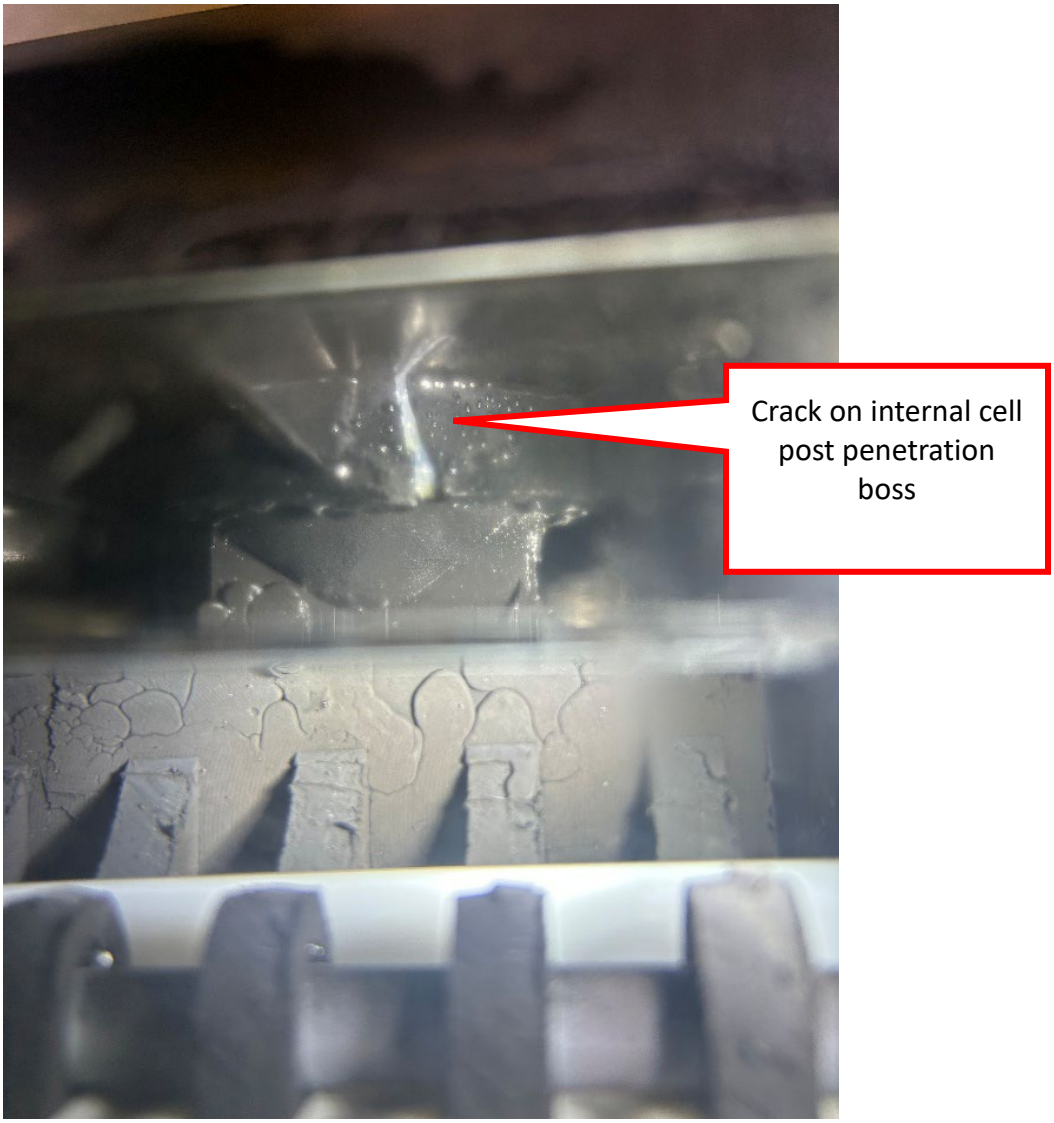

Figure 5

Battery Cabling Support – intercell/tier battery cabling should be well supported with sufficient bend radius to minimize post stress.

Figure 6. Unsupported Inter-Tier Cabling

Cell Alignment – Cells should be arranged in the racks to prevent unwanted misalignment which could contribute to stress at the battery terminal post.

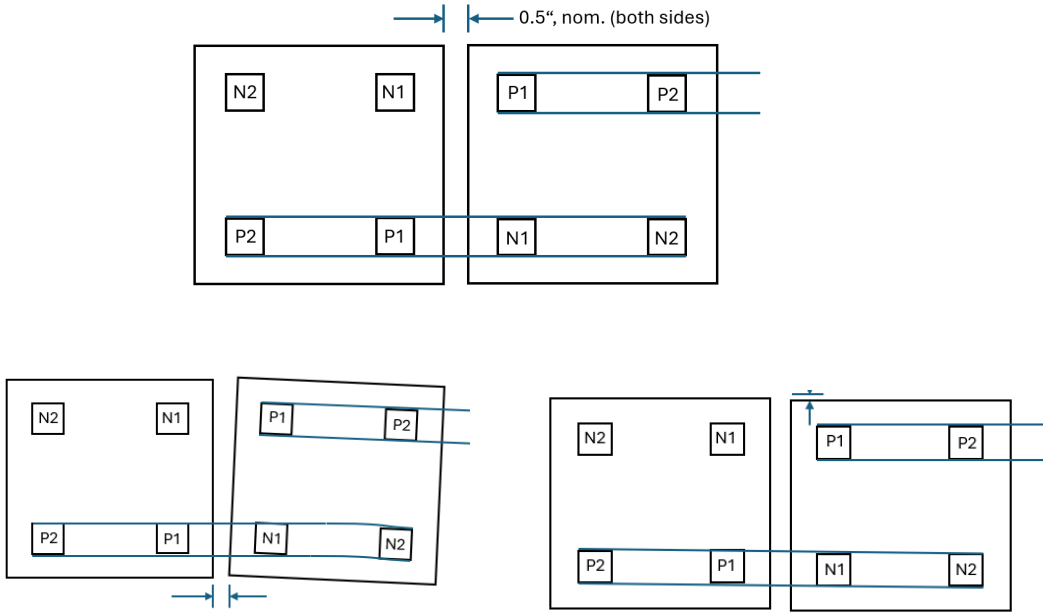

Figure 7: (Top) Ideal Cell Alignment, (Bottom Left) Unwanted, Rotated Cell Alignment, (Bottom Right) Unwanted, Shifted Cell Alignment