

Latch Improvement Safety Analysis

September 21, 2021

Introduction

As noted in both the TWG and ERCAS reports, process improvements need to be made to ensure that all fuel elements are latched. Management, procedural, training, and oversight issues are addressed in the corrective actions outlined in the Root Cause Response report. In addition to the changes identified in the reports, this document provides a safety analysis of the proposed latch verification improvements and describes how they provide complete protection against an element remaining in an unlatched state as outlined in IE-CA-2 of the ERCAS report.

Issues

The following is a list of issues that were identified with the previously existing procedures for verifying a fuel element was latched:

1. Because of the difficulties in providing a direct visual indication of the latch, latching was verified by the position (height and rotation) of the pickup tool while it was attached to the element.
2. The fidelity of height checks is inadequate to provide assurances of latching. Multiple measurements and checks determined that measurements of tool height were not a reliable indication of the latch state of an element. The tolerances in the measurements were not adequate to verify the latch state.
3. Rotational checks of the tool were made without adequate marks on the index plate for reference. The checks were made and the adequacy of the extent of rotation was determined by operator experience. There were no reference marks on the index plate for rotation latch checks as described in existing procedures.
4. During testing it was determined that it is possible to inadvertently unlatch an element by a transferring mechanical impulse from the pickup tool. Because of the stored force in the compressed and rotated spring of the latch, a small impulse from a tool was enough to unlatch an element partially or fully.

Proposed Improvements

The latching of elements will be verified using two processes. The first will be a verification of the rotation of the latching tool to the proper position. The second and final verification will be a visual examination of each latch to verify that it is in the fully latched position. The following is a list of improvements that will be implemented:

1. Implementation of a Final Visual check. The use of a video system, currently under construction, will be implemented and mandated as the last check prior to a reactor startup and after all pickup tools are stowed. Each element will be visually verified to be latched, as required by TS 3.9.2.1(3) by review of the video, checking the element head or latching bar. Once the visual verification is performed further manipulation of fuel elements will not be permitted without an additional visual check.
Analysis: This will provide unambiguous evidence that all elements are fully latched. As this is the last check, and because no use of the pickup tools will be allowed after this check, there is no possibility that an element could subsequently become unlatched. Note: The likelihood of coolant flow unlatching a fully latched element is not credible.
2. Discontinuation of height checks. Height checks will no longer be part of the latch check procedure as they do not provide a clear indication of latch status.
Analysis: A detailed dimensional study and empirical measurements of the tooling and index plate has shown that there is inadequate fidelity in a height check to provide absolute assurance that an element is latched. Attempting to do so could give a false sense of security, particularly when the other improvements given here are much more robust.
3. Utilization of clear Index plate marking. Clear fiduciary marks will be made on the index plate to verify proper azimuthal rotation in the latched position. This will satisfy requirements of TS 3.9.2.1(2). Verification of this position will be made by a second individual, providing redundant verification.
Analysis: Markings will be made in such a way as to provide unambiguous indication that the element is latched into position. Any unlatched or partially latched elements would be immediately recognized.

Summary

Going forward, there will be two verifications of fuel latching:

- 1) a rotation check (with redundant peer check) using clear fiduciary marks, and
- 2) a visual check using video equipment after all fuel movements are complete.

Each of these independently satisfies the latch check requirements in TS 3.9.2.1 and provides unambiguous verification that an element is latched and eliminates the possibility of a reactor startup with an element unlatched.