Temporary Reactor Head

Outage and Maintenance Solutions

Summary

In order to minimize the length of a refueling outage, nuclear utilities are constantly seeking new ways to improve their outage processes, often doing multiple tasks in parallel to decrease outage duration and increase productivity. Curtiss-Wright's Temporary Reactor Head (TRH) is designed to enable the refueling cavity to remain flooded while the reactor vessel coolant level is lowered, allowing for multiple activities to be performed at the same time.

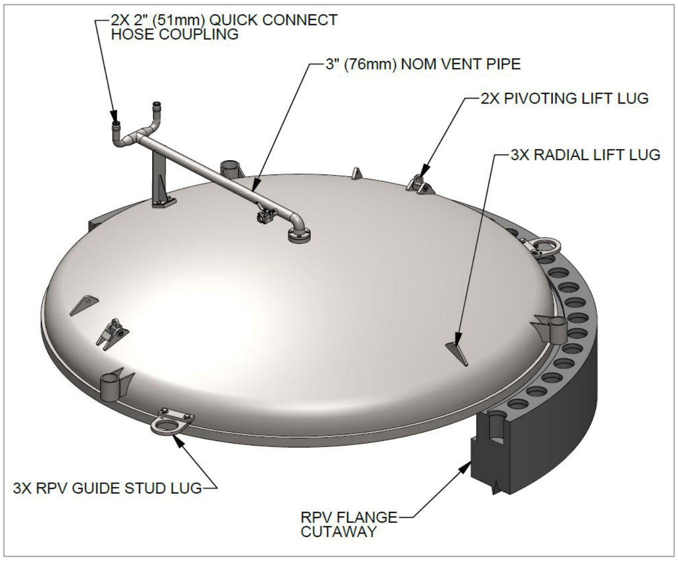
INTRODUCTION

During a refueling outage, some of the most critical activities take place in and around the reactor. While all of these tasks are necessary, some of them can seem to be mutually exclusive, such as when one task requires the refueling cavity to be flooded while another requires that the reactor coolant level be lowered below the reactor pressure vessel (RPV) flange level. Many of these maintenance functions are vital to nuclear plant health; activities such as split pin replacement, ICI replacement, and CEA modifications all require the refueling cavity to be flooded, but activities like reactor coolant pump repair, emergency core cooling system valve maintenance, and steam generator maintenance need the coolant to be lowered.

Curtiss-Wright's Temporary Reactor Head is a temporary reactor vessel cover that is designed to seal the RPV from the refueling cavity after the RPV head is removed and the reactor is defueled, allowing once mutually exclusive maintenance activities to be performed simultaneously. The TRH primarily consists of a flanged, dished head made entirely of type 304 stainless steel and an elastomer compression seal molded from radiation-resistant ethylene propylene diene monomer (EPDM). This shape and construction ensures a tight seal while also avoiding the O-ring seal zone and the inner cylindrical RPV flange recess. The elastomer compression seal is structured so that it can be snapped quickly and easily into place during installation, and the dual seal configuration allows for leak-checks prior to vessel drain and during use if desired. Clearances are maintained by the TRH's removable RPV guide stud lugs which guide the head along RPV guide studs. Three removable support legs are supplied to allow placement of the TRH above floor level for protection of the compression seal and at a convenient elevation for seal inspection and replacement.

Figure 1: A Temporary Reactor Head installed during a maintenance outage

Temporary Reactor Head



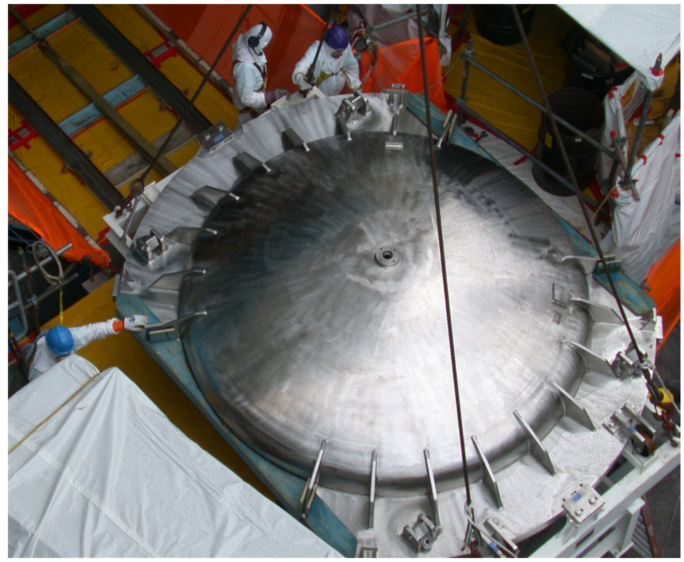


Figure 2 & 3: Side view of a Temporary Reactor Head (left) and a segmented TRH being transported into containment (right)

Curtiss-Wright has supplied over a dozen TRHs to a variety of nuclear plants across America. In addition to time saved, TRH users have reported a decreased risk of damage to the RPV head and reactor internals due to eliminated critical lifts, less water to process from the refueling cavity since it can remain flooded, and decreased radiation exposure from submerged components since the refueling cavity.

APPLICATIONS

One of the activities scheduled during a nuclear utility's spring refueling outage was to perform a RPV head control rod drive mechanism nozzle examination. This examination is infrequently performed and requires the reactor head to remain in the RPV head stand for extended periods of time to support the necessary robotic inspections.

The utility realized that to maintain their 25-day outage schedule, there had to be a way to drain down the reactor coolant system to support the steam generator nozzle dam installation while also allowing the RPV head to remain in the stand for inspection. Their Reactor Services and the refuel High Impact Team took the lead and performed the research, benchmarking, and review of operating experience to determine what kind of TRH was needed – the TRH had to ensure safe and reliable deployment and retrieval while ensuring radiation protection at all times. An additional concern was how to transport the TRH in and out of containment in a storage box to support both radiation protection and long-term storage outside of containment.

Curtiss-Wright's TRH was chosen, arriving a few days before the outage and packed and staged outside of containment. A special box with rollers was designed and fabricated to facilitate transport through the outage equipment hatch. Once the cavity was flooded and the reactor defueled, the TRH was set without incident, staying safe and event-free while supporting mid-loop work. After the mid-loop work was completed, the TRH was removed from the cavity and removed from containment, again without incident. This was a successful first-time evolution for the utility and advantageous as it saved over 30 hours of critical path time and significantly reduced radiation exposure.

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