

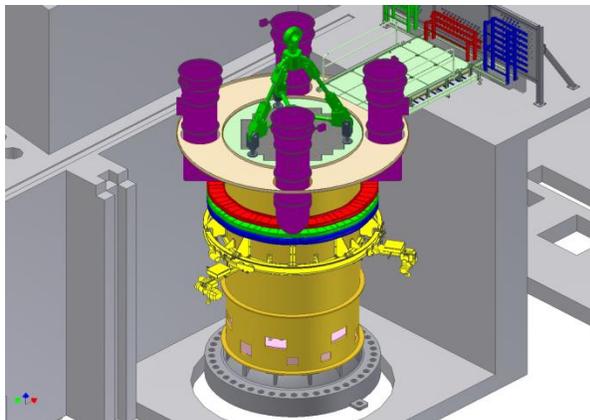
Simplified Head Assembly

Background

Reactor head disassembly and reassembly activities are major considerations when it comes to the refueling outage critical path schedule, personnel radiation exposure, critical containment resources, personnel safety and cost.

The Westinghouse integrated Simplified Head Assembly (SHA) is an enhanced equipment design that offers a significant improvement in outage duration and safety. The SHA includes features specifically designed to reduce the efforts associated with disassembling and reassembling the reactor head in support of plant refueling

Westinghouse is the OEM, design authority and manufacturer for the **AP1000**[®] pressurized water reactor (PWR) Integrated Head Package (IHP) for Sanmen1&2 and Haiyang 1&2 China units and U.S. AP1000 PWR units. The IHP installed at the AP1000 plants across the globe incorporate the SHA philosophy.



**AP1000[®] Plant Integrated Head Package
(China and U.S. Plants)**

Description

Specific designs of SHA are developed and customized for individual plants. These designs can range from an optimization of the plant's existing ductwork to a complete integrated package redesign incorporating radiation shielding, the Control Rod Drive Mechanism (CRDM)/Control Element Drive Mechanism

(CEDM) cooling system with fans, a cable management system and a permanently installed missile shield.

The SHA incorporates:

Radiation shield and cooling shroud assembly attached to the reactor vessel closure head at the CRDM/CEDM elevation. The CRDM/CEDM cooling system can include fans installed onto the head assembly; locating the fans away from the closure head eliminates the need for ductwork removal/ installation on the closure head.

Reflective Insulation: Can be designed and installed as part of the SHA upgrade. This approach provides cost and thermal insulation performance benefits, which allows optimization of the CRDM and DRPI/RPI cooling system.

CRDM Cooling Fan and Duct Optimization: The quantity of the CRDM cooling fans and ducts may be reduced while maintaining existing CRDM and DRPI or RPI coil stacks.

An integral missile shield, attached to the existing plant lifting rig, eliminates the need for a separate missile shield and the associated handling and storage.

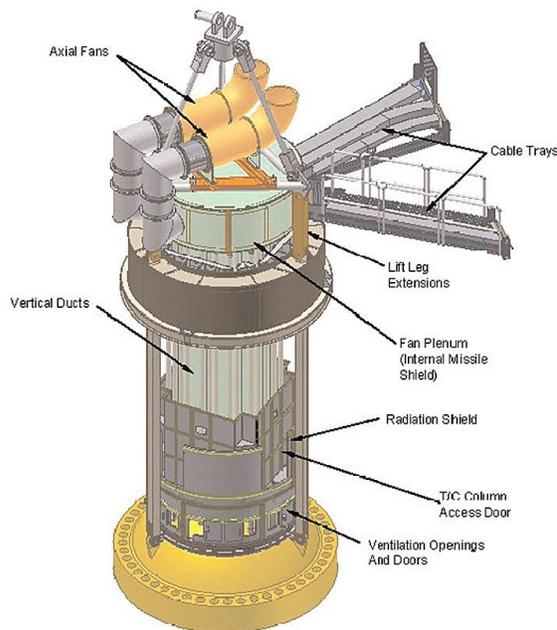
Cable Bridge and Connections: Improvement of the CRDM/CEDM and RPI cable management can be realized by incorporating a bridge or bridges that contain connector panels. Depending on the containment layout, these bridges can be mounted either on the seismic support platform or on the containment floor.

With the SHA in place, the preparation for head lift is reduced to disconnecting the cables at the common connector panels, swinging the cable bridge clear (either manually or electrically), removing the seismic tie rods and connecting the polar crane to the head lift rig. After de-tensioning and removing the studs, the head is ready to be lifted.

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Key Features Summary:

- Integrated shielded work platform
- Integrated fans and ductwork
- Reflective insulation
- Maintenance and inspection doors
- Installation package
- Integrated missile shield
- Cables routed in raceways to comply with electrical requirements
- Retractable cable bridges to quickly support RVH removal
- Installation of circumferential trolleys and radial hoists to support stud tensioner and cavity activities
- Utility power for maintenance activities.
- Airflow doors to provide inlet air to cool CRDMs



Reactor Vessel Head with Simplified Head Assembly Upgrade Example

Summary of Benefits

The SHA package can provide a number of benefits:

- Significant reduction in critical path time of **four to six days**
- Reduction in personnel radiation exposure associated with reactor head disassembly and reassembly activities (**five to 10 rem at most plants**)

- Reduction in critical containment building resources, thereby freeing resources to support other activities
- Reduction in polar crane usage and containment laydown space
- Reduction in risks to plant personnel safety programs associated with the disassembly and reassembly of CRDM/CEDM cooling system duct work, missile shield and other activities
- SHA installation performed within a normal refueling outage schedule
- Improvements to head vent routing and connections

Deliverables

Westinghouse can provide the following as part of the SHA package implementation:

- A complete design package including assembly and arrangement drawings, as well as a design report
- New SHA components
- CRDM/CEDM, RPI/DRPI, and other miscellaneous Instrumentation, Control and Power Cables to meet each customer's needs.
- Quality assurance documentation associated with the hardware
- Licensing assistance
- Plant change package input
- Installation services

The lead time required for the SHA is approximately 24 months. Installation is completed during the refueling outage, which can be done without impacting the outage critical path schedule.

Experience

Westinghouse has completed design and installation of 26 SHA upgrade packages and has also designed and implemented similar features for the original Combustion Engineering fleet of plants.