

Drywell Permanent Shielding at Pilgrim

Pilgrim Station is a 670 megawatt GE BWR 3 with a Mark 1 containment. The plant is located on the shore of Cape Cod Bay in Plymouth, Massachusetts. Historically, the Pilgrim Plant has been a high source term BWR. Its annual occupational dose has been below average: 60-70% of the dose received by plant workers is from the drywell.

Permanent Shielding Plan Developed:

Prior to 1996, 16-20 REM each refueling outage was spent installing 20-30 tons of temporary lead shielding in all areas. In 1996, a plan was developed to reduce occupational exposure by installing permanent shielding in the drywell of the plant. Justification for this approach was based on:

- 10 REM temporary shielding installation cost per refueling outage
- High occupancy times in the drywell
- Personnel safety concerns with repetitive temporary shielding installation in the drywell
- Emergent work and forced outages - shielding already installed

The plan called for the installation of lead blanket curtains in the drywell because curtains could be fit into tight work areas. Curtains or shadow shielding could be installed in vertical configurations from drywell internal structures that could be more easily qualified than direct shielding on pipe. Also, the drywell represented the site most difficult and large scope temporary installation. Finally, shielding hung from structures allowed increased direct loading of temporary shielding on pipes.

Plan Implementation:

Plan implementation provided for the direct application of permanent shielding on the **RHR suction, discharge and cross connect piping** in the drywell. The limiting factor was determined to be the design temperature of the piping (- 300°F), with plant on-line or off-line. Lead blankets were used with Alpha Maritex covering rated for 500° (conventional blankets covers are generally only qualified to 150°F). Pipe loading permitted 80-120 Lbs / linear feet (2-3 layers). Standard stress calculations used by engineering to approved the permanent shielding packages. The Second Area for permanent shielding was the direct shielding of the lower Residual Heat Removal Heat Exchanger (RHR Hx)Heads. Approximately, ton of alpha maritex was installed with a minimum of 4 layers. The type of shielding installation consisted of suspending the lead blankets on load rated chains and connectors from the lower head flange.

Scope:

The actual scope of the completed permanent lead installation is summarized below:

- Applied 4 layers of qualified Alpha Maritex blankets around exposed vertical portions of

- ten 12 inch N2 recirc risers. Each curtain weighs 1700 Lbs.
- For 28 inch risers used overhead structural steel framing for support
 - Blankets are high density (15 Lbs/ft²)
 - Supported by pipe rupture restraints fastened to the bio shield wall just below the N2 nozzles
 - Hardware to support blankets:
 - 1) special brackets designed to fasten around rupture restraints, and
 - 2) conventional, load rated spring clips and chain connectors.

Blanket Qualification:

- Biggest aspect of the project was approval of blanket material due to potential LOCA effects and debris loading on ECCS strainers.
- Alpha Maritex is a high temperature, flame retarding, silicone rubber impregnated fabric.
- The fabric was initially identified for consideration due to its performance during air jet impact testing to simulated DBA pipe break jet impingement forces.
- Follow up Pilgrim specific test program implemented to determine effects of simulated LOCA environment (dose equivalent to 40 year plant life followed by temperature, pressure, and spray).
- The material was tested for physical strength characteristics before & after, demonstrating strength reductions to be within acceptable limits
- The blanket grommets were demonstrated to have a substantial factor of safety based on testing for their 55 lb. design load
- To summarize, testing provided assurance that the blankets would not degrade in a manner which would result in them falling on to Class I equipment, or becoming a contributor to torus debris loading due to LOCA effects.

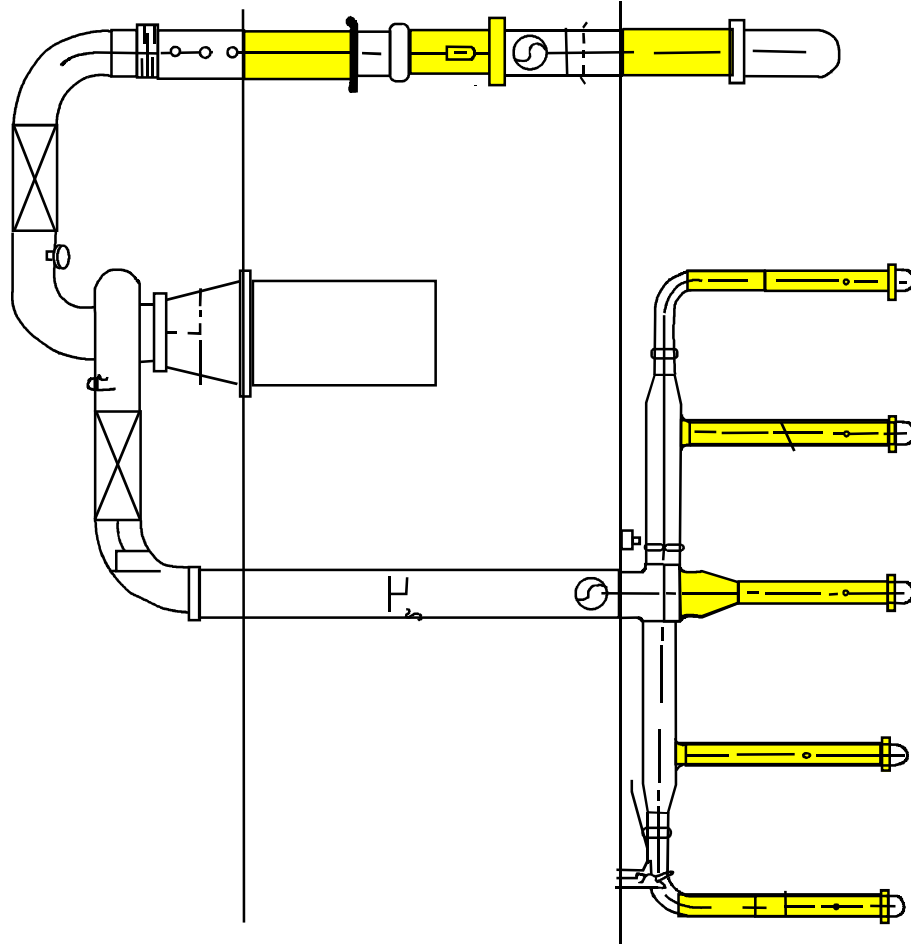


Figure 1: **RECIRC SYSTEM Permanent Shielding Area**

Future Drywell Shielding:

With the success of the initial permanent shielding installation project, plans are underway to install additional permanent shielding at Pilgrim. The following 2 areas are top candidates for the next project scope:

- Remainder of recirc and RHR dose contributors including discharge headers, 28” risers including the 6” reactor water cleanup (RWCU).
- Options being considered include Alpha Maritex blankets, shielded metal pipe insulation, and steel plate structures.

Summary:

The installation of permanent shielding at Pilgrim has been proven to be an effective tool to reduce site occupational exposure without compromising plant safety.

