Update on Fiberglass-Reinforced Plastic (FRP) Reliability in Wet FGD Applications

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FRP has a long history of success in utility stack liner and ductwork applications

<table>
<thead>
<tr>
<th>Station/Unit</th>
<th>Year Installed</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronado 1</td>
<td>1979</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Winyah 3</td>
<td>1980</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Coronado 2</td>
<td>1980</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Winyah 4</td>
<td>1981</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Laramie River 3</td>
<td>1982</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Holcomb 1</td>
<td>1983</td>
<td>Good condition, min. maint. req.</td>
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<tr>
<td>Cross 2</td>
<td>1983</td>
<td>Good condition, min. maint. req.</td>
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<tr>
<td>North Valme 2</td>
<td>1985</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Intermountain 1</td>
<td>1986</td>
<td>Good condition, min. maint. req.</td>
</tr>
<tr>
<td>Intermountain 2</td>
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</tbody>
</table>
As with all materials, FRP has requirements for success

- Proper resin selection and corrosion barrier design to maximize Corrosion resistance to the environment
- Designed by experienced and qualified FRP engineers
- Properly fabricated and installed by knowledgeable and experienced personnel
- Properly maintained by qualified personnel
Corrosion resistant FRP must have a corrosion barrier of at least 100 mils.

- 90 mils of chopped mat (75% Resin)
- 10 mil veil (90% Resin)

Corrosion Barrier (CB) Structural Portion
100 mils minimum required

Up to 75% glass for strength
Advantages of corrosion resistant FRP in wet FGD applications

- Significantly less expensive than solid C-276 high nickel alloy
- Less expensive than C-276 clad carbon steel and 2205 stainless steel
- Lower maintenance than acid brick-lined
- Lower life cycle cost than acid brick-lined or stainless steel
FRP scrubber hood (128 x 34 x 32 ft.) saved utility $4.2 MM compared to C-276
2004-2010 showed significant increase in use of FRP in FGD applications

- 70 FRP stack liners
- 24 FRP jet bubbling reactors
- 75 FRP limestone slurry systems
Large FRP jet bubbling reactor (600MW) successfully operating since 2007
New resin developments

- Clear, easy to inspect, Class I E-84 laminates without the use of antimony

- Derakane® 510B-400 epoxy vinyl ester resin
  - 227°F HDT ideal for wet FGD applications

- Hetron® FR998-35 epoxy vinyl ester resin
  - 275°F HDT ideal for hotter applications
Conclusions

- FRP has a long history of success in FGD applications
- Proper design, fabrication and maintenance are the keys to success
- New developments in resin technology have made FRP an even more attractive solution