Lightweight Polymer Arresters Allow Upgrade of Mobile Substation

by Lee Ayers Mid-Carolina Electric Cooperative

About the Author

Lee Ayers, System Engineer for Mid-Carolina Electric Cooperative, Lexington, South Carolina, received his B.S.E.E. from Clemson University in 1982. In his current position, Lee is responsible for all System Planning as well as Substation Engineering and Construction.

Mid-Carolina Electric Cooperative serves 35,000 members on 2900+ miles of line in a five county area in the central part (Midlands) of South Carolina. Our service area varies from very rural to urban. We provide quality service to our customers with a good mix of overhead and underground at voltages of 25kV and 12.5kV.

With many miles of failing older underground cable not yet replaced with EPR (Kerite is one of two now being purchased), a very thorough study of arrester application was made. The failures of the older cables show a direct correlation to our summer lightning storms. Older gapped arresters have now been replaced with new MOV's along with serious attempts to improve grounding. (We have many locations with 4800 soil resistivity!)

We own a very useful 20 MVA mobile substation. We, along with other South Carolina electric cooperatives, have used this during emergency situations throughout the state. This unit has moved from storage in Lexington, SC to "in service" at off-property locations in as little as six hours.

Because of the possibility of poor grounding at some locations and older gapped silicon arresters, the decision was made to upgrade our mobile sub with new MOV's. Lightning protection of this transformer has become very important not only due to emergency service restoration, the replacement cost of the unit is now estimated at over $1M. The new Ohio Brass polymer-housed PVN Station Class arrester was chosen for this retrofit.

The high side of the transformer has a dual voltage rating of 115kV and 69kV. A dual rated arrester was selected with the full two unit stack duty cycle rating of 96kV (77 MCOV) and a "half" stack rating of 60kV (48 MCOV). A shorting bar was provided to short out the lower 36kV arrester unit when the mobile sub was used at 69kV. The total net weight of the complete arrester is only 104 pounds. The porcelain equivalent would be over 350 lbs!

The low side of the transformer is also dual rated at 25kV and 12.5kV. A single arrester was selected for this application rated 21kV (17 MCOV). This was the proper size for the unregulated 25kV bus at some locations. While the 17kV MCOV seems rather high for normal protection when installed on 12.5kV bus, the new MOV's have such low discharge voltages that adequate protection is provided. There are also 8.4 MCOV Intermediate MOV's installed on the 15kV station bus for more conventional protection.

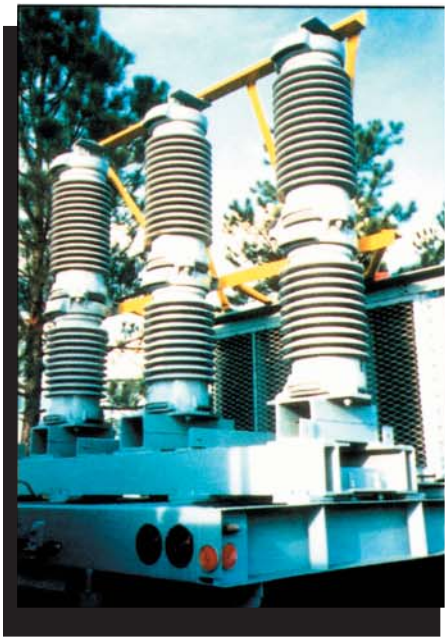
One of the several advantages in using polymer housed PVN's is the tremendous weight differences. By taking off the old porcelain gapped silicone carbide arresters, enough weight was saved to add external slipover CT's to the mobile sub. Maintaining the trailer GVW was very important, thus we were able to upgrade our equipment at no increased weight. Another advantage is the elimination of road hazard damage to the arresters. Several of the old porcelain units had chipped and broken skirts.

The polymer-housed MOV arrester is inherently safer, too. Safety for our crews as well as safety to the equipment if an arrester was to fail is very important. The transformer is particularly vulnerable as its bushings, tank, and radiators are in very close proximity to the arresters.

We also had to use a very heavy steel brace assembly for highway travel to protect the old porcelain arresters from damage in travel. Another piece of equipment (boom truck) would have to be scheduled to the emergency site just to lift off this brace. The new PVN's do not require a brace but we fabricated one anyway out of scrap aluminum bus we had. One man can now unbolt the new brace and lift it off.

Mid-Carolina has not had to use our mobile transformer since the retrofit and upgrade; hopefully, we won't. But we are ready with a well-protected transformer if an emergency occurs.

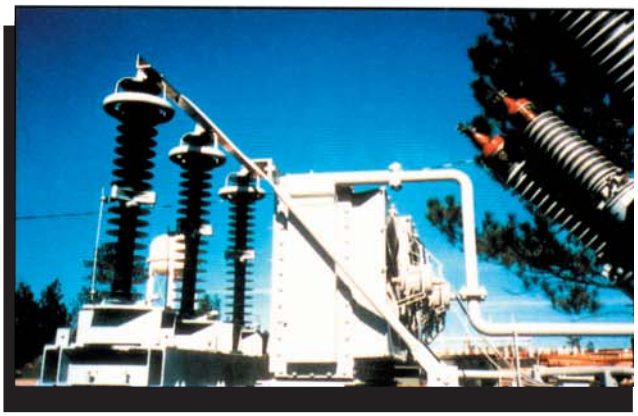
Mobile sub after retrofit.



Old silicon gapped arresters.

New PVN arresters.

New 21kV PVN arresters.



Proximity of high voltage arresters to forced-oil radiators and high voltage bushings was of great concern.

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EU2874-HR

Reprinted from Hi-Tension News Third-Fourth Quarters, 1994