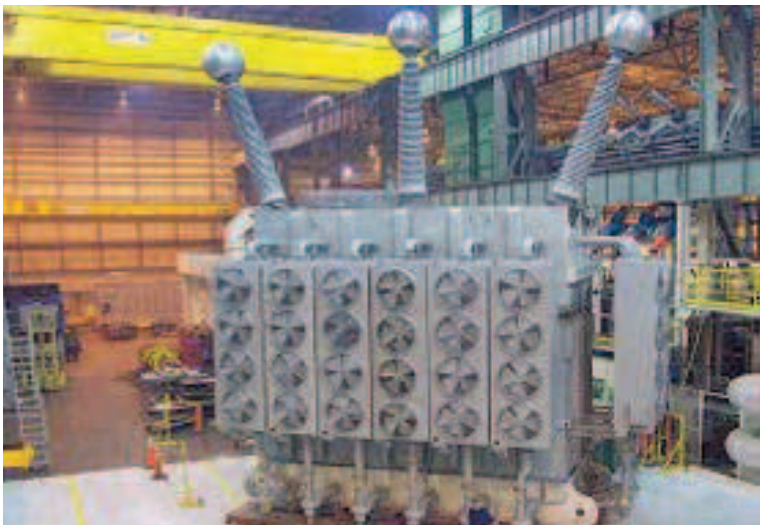
TURNKEY SOLUTION HELPS ENTERGY REDUCE DOWNTIME AND LOST REVENUE DUE TO FAILURE OF A KEY TRANSFORMER

Entergy, one of the world's largest Investor Owned Utility companies, owns and operates White Bluff Plant, a coal-fired power generating station in Redfield, Arkansas. Entergy experienced a winding failure in one of their generator step up transformers (GSU) at this location that crippled their ability to supply power. The failed transformer represented fully half of their capacity at White Bluff.

THE PROBLEM

There was no readily available way to completely replace the transformer. The transformer was a shell form, 910 MVA, 500 kV, 1425 kV BIL GSU transformer. The only replacement that Entergy was able to obtain was the smaller 500 MVA model.

So, until Entergy was able to obtain a full-sized replacement, the plant would be operating more than 400 MVA below capacity. The amount of lost revenue was huge due to the lost capacity. Entergy had to find a way to minimize the cost. The most critically important factor in finding a solution to the failed transformer problem was to minimize this lost revenue.



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THE SOLUTION

The obvious answer to the time constraints was to remanufacture the GSU transformer. Ohio Transformer (OT), an S. D. Myers company, was one of the few companies that possessed the needed expertise and capabilities to fix the unit. Entergy reviewed its options and decided to award a turn-key contract to Ohio Transformer because of their experience with remanufacturing large shell form transformers. It minimized the time needed to execute all of the necessary tasks and functions in all facets of the project from draining, disconnecting and preparing the unit for shipment, through transportation, design remanufacturing, and testing, to delivery and installation of the remanufactured GSU.

To minimize the outage and Entergy's lost revenues, Entergy and OT set "impossible" turnaround goals - to finish the project in 32 weeks.

THE TRANSFORMER AND REMANUFACTURING DATA

The transformer is a Westinghouse shell form GSU transformer, 910 MVA, three phase, 60 Hz. The Primary (LV) is 25 kV Delta, 125 BIL. The Secondary (HV) is 500 kV Wye, 1425 BIL, with neutral at 25 kV. The total weight of the fully dressed transformer, completely filled with oil is 1,490,000 pounds. It was originally manufactured in 1974.

Ohio Transformer redesigned the transformer per the latest ANSI standards, incorporating state of the art materials and

remanufacturing techniques. Completely new windings were manufactured, and new contour insulation was utilized. New components were incorporated into the design of the transformer. These included a Hydran 201R Gas in Oil Monitor, Weschler Temperature Gauges, Doble IDD Bushing Diagnostic System, oil flow gauges, and nitrogen readout/transducer.

OT also custom built a new, state-of-the-art control cabinet. This PLC controlled unit allows auxiliary functions of the transformer such as cooling, relays, alarms, control devices, and other systems to be monitored from Entergy's main control room at the generating station or even over the Internet from anywhere in the world.

TURN-KEY PROJECT SCOPE

Outline of project segments included in the scope of the turn-key solution:

- In-field project engineering
- Draining, disassembly, and shipment to OT facility in Bradenton, Florida
- Rigging
- Transformer redesign
- Remanufacture with new insulation and windings
- Restacking and reassembly
- Engineering and installing new components
- Manufacturing new state-of-the-art-control cabinet
- Factory and field testing of transformer according to ANSI/IEEE standards
- Bracing and dressing for shipment
- Delivery to Entergy plant
- Transformer assembly, field dressing, installation, and vacuum filling

Due to the aggressive schedule needed to minimize turnaround time, Ohio Transformer had to begin to redesign the unit before it actually arrived at Bradenton. The field services crew, equipment, and engineering support arrived at the White Bluff Plant and did a fair amount of the redesign engineering during the field project to drain, disconnect, disassemble and brace for shipping, and rig out the failed unit. Transportation from Arkansas to Bradenton, Florida, involved both barge shipment and rail. By the time the transformer arrived at the shop, Ohio Transformer had already completed most of the redesign engineering and had begun winding the new coils. Plus, new components such as the new control cabinet were also being built.

The redesign of the transformer was accomplished using current ANSI standards, and a new insulation package was installed. All windings and wiring were replaced. The tank, core steel, major support structures, and other components were refurbished and reused, as appropriate.

The original transformer had been manufactured in 1974. There have been some minor improvements in the efficiency for some materials that were reused, such as core steel and fans. However, the redesign of the winding and insulation packages according to modern ANSI standards more than compensated for this. The final design and the actual remanufactured transformer were, in many ways, superior to the original equipment. The remanufactured unit has proven to be a cost effective alternative to a new unit - and was available in a fraction of the time that would be required for a new transformer.

Upon completion, the unit was assembled in Bradenton and subjected to a complete set of factory tests according to ANSI/IEEE standards. The unit was partially disassembled, braced, and dressed for transportation to the site. Ohio Transformer was again responsible for transportation back to White Bluff Plant. An OT crew arrived shortly before the transformer did to prepare for the installation.

Once the transformer arrived, it was rigged into position and internal temporary bracing was removed. The unit was completely assembled and vacuum filled. After required settling time, it was tested according to ANSI/IEEE standards for acceptance electrical testing. Upon passing, the unit was reconnected, and the installation was completed. The OT crew stayed on site until the unit was energized and back on the power grid, replacing the small interim GSU with full power.

Entergy was able to return to full production in considerably less time than it would have taken to engineer and purchase a replacement transformer from other sources, and the project came in on time and on budget.

Tank lowered over core and coils

THE BOTTOM LINE

The cost of a 910 MVA, 500 kV, 1425 BIL GSU transformer is a very substantial investment. In this case, although the remanufactured unit was a superior, cost effective alternative to a newly manufactured replacement, that was not the key factor in forcing the decision toward an Ohio Transformer turn-key project based on redesign and remanufacturing. Minimizing the outage and reducing the period of restricted capacity were the critical factors.

The complete and accurate cost difference and savings in lost revenues are proprietary information, but the scope of those savings can be illustrated. The entire OT project, start to finish, required 32 weeks to complete. The lowest of the best estimates of the time just to manufacture a new transformer of similar size and capacity were weeks longer than this value. Add on to that the time that would be required to do the up front engineering and then to transport and install the new unit. Conservatively, the actual time difference would be several months - while the plant operated with 400 MVA less capacity.

The project between Entergy and Ohio Transformer was very effective in minimizing the financial damage brought on by this unplanned and unexpected outage and transformer failure. **ET**